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BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY

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TRANSPORTATION PLAN

BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY

Prepared for

THE STATE HIGHWAY COMMISSION
OF THE STATE OF MONTANA AND
THE CITY OF BILLINGS

In Cooperation With

THE U. S. DEPARTMENT OF COMMERCE
BUREAU OF PUBLIC ROADS

FEBRUARY 1964

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CHICAGO, ILLINOIS 60601
FINANCIAL 6-0424 · AREA CODE 312

February 28, 1964

The State Highway Commission
of the State of Montana
Helena, Montana

Gentlemen:

We are pleased to submit our report "Transportation Plan for the Billings Metropolitan Area". The report presents recommendations and estimates of cost for a transportation system designed to meet the needs of the Billings Metropolitan Area over the next two decades.

Field surveys were made in 1961. Basic data acquired through these surveys have been summarized in detail in two reports previously submitted to you--"Basic Data on Parking", March 1962; and "Basic Data on Traffic--1961", February 1963.

Descriptions of the surveys and highlights of the data acquired are presented herein. In addition, the methodology of expanding the data to 1981, as well as the results of the expansion, are described in detail.

With certain exceptions, the existing street system in the Billings area is adequate to meet present needs. Extensive improvements, which we have estimated would cost over $20,000,000 at current price levels, will be required, however, by 1981. It has been estimated that total vehicular traffic in the area will double in the next 20 years. It is imperative, therefore, that plans and construction of recommended improvements be started as soon as possible.

Since a final decision has not yet been reached with regard to elimination of railroad grade crossings in Billings, the recommended arterial street plan was analyzed under two alternative assumptions--partial elevation of the Northern Pacific Railroad tracks near the central business district or relocation of the railroad to an

alignment paralleling proposed Interstate 90. It was found that the recommended system would have adequate capacity in either case.

We appreciate the wholehearted cooperation and assistance of your staff, as well as officials of the U.S. Bureau of Public Roads and City of Billings. We also received valuable assistance from numerous organizations and individuals in Billings.

We are pleased to have been afforded the opportunity to undertake this important assignment and sincerely hope that it will be of value to those entrusted with future planning in Billings.

Very truly yours,

DE LEUW, CATHER & COMPANY

Walter A. Barry, Jr.

Walter A. Barry, Jr.
Chief Traffic and Transit Engineer

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Chapter I

INTRODUCTION

The City of Billings, located in Yellowstone County in south central Montana, was established in 1882, and named for Frederick Parmly Billings, then president of the Northern Pacific Railway. The railway was, indeed, the most important factor in determining the location of the city. A small trading post named Coulson--located about a mile southeast of the center of the present city--was actually settled about six years before. The trading post was abandoned, however, when it was decided to locate the railroad station at its present site in Billings. Prior to 1876, settlement of the area was impossible due to hostile Indians.

The economy of Billings was initially based on agriculture and commerce. These characteristics have carried through to the present time with one major addition--oil exploration and production. The oil industry in the area realized its greatest growth in the early 1940's when oil was urgently needed for the nation's war effort. Elk Basin in northern Wyoming was discovered during this period, followed some years later by discovery of Williston Basin in eastern Montana and western North Dakota. Two refineries in Billings and another in Laurel refine crude oil taken from both basins.

A company was formed in Billings in 1882--the year the city was first settled--to build the area's first irrigation ditch. This was followed by additional irrigation projects which have transformed the semi-arid but fertile Yellowstone Valley into productive farmland. Agriculture and related services have played an important part, therefore, in the development of the area.

Billings is also a major regional trading center for a large section of the Northwestern States.

EXISTING TRANSPORTATION FACILITIES

The Billings urban area is presently served by three U.S. highways, two State highways, three railroads and three airlines. Two Interstate highways, now in various stages of completion, will provide improved access to the area in the future.

Major Streets and Highways

Highways serving the Billings area are shown in Exhibit 1. U.S. Highway 10, a major east-west route extending from Detroit to Seattle, passes directly through the center of the city on First Avenue North. This important highway connects the Billings region with Miles City and Glendive in eastern Montana as well as with Butte, Missoula and Helena (via U.S. 12) in western Montana.

U.S. Highway 87 extends from Harve, Montana, near the Canadian border, to Port Lavaca, Texas, passing through such major centers as Cheyenne, Wyoming; Denver, Colorado; and Amarillo and San Antonio, Texas. The route of U.S. 87 through Montana is somewhat indirect, proceeding westerly to Great Falls, then easterly through Lewistown before assuming a more north-south alignment through Billings and south to Sheridan, Wyoming. This route actually skirts the city on the east side, joining Routes 10 and 312 about four miles north of the city limits and turning east at First Avenue North.

U.S. 212 extends from Minneapolis, Minnesota to Billings, joins U.S. 10, and follows this route to Laurel, at which point it turns southwest and continues as far as the Silver Gate of Yellowstone Park.

Beginning at Broadus, U.S. 312 proceeds to Miles City and, following the same route as U.S. 10, terminates at Billings.

Montana Highways 3 (primary) and 302 (secondary) enter Billings from the northwest. Highway 3 provides a

shorter connection to U.S. 12 and the west than would otherwise be available using U.S. 87.

Exhibit 1 also shows the proposed location of Interstate Highways 90 and 94 in the Billings region. Interstate 90 will be the major transcontinental route through the northern states. It will begin in Boston and pass through Cleveland, Chicago, Sioux Falls and Rapid City before it turns north to Billings near Buffalo, Wyoming. Interstate 94 follows a more northerly alignment than Interstate 90. The two routes split near central Wisconsin and join again just east of Billings. Interstate 94 passes through such major cities as Minneapolis, Fargo and Bismarck.

Railroads

Billings is served by three major railroads--the Northern Pacific, the Great Northern and the Chicago, Burlington and Quincy--which have a joint operation within the area. The main line of the Northern Pacific follows the valley of the Yellowstone River through eastern Montana, and traverses the City of Billings on a straight diagonal line from the northeast to the southwest. The CB&Q operates over the Northern Pacific under trackage rights agreements easterly to Huntley and westerly to Laurel. The Great Northern also operates on Northern Pacific tracks between Mossmain (12 miles west of Billings) and the Great Northern branch line in the vicinity of Great Falls.

Airlines

Three major airlines serve the Billings area--Northwest Airlines, Western Airlines and Frontier Airlines. Northwest flights through Billings extend from Portland and Seattle to New York. Frontier and Western routes are predominantly north-south from Albuquerque and Denver through Billings to Great Falls. The Billings airport is also the hub of numerous flights by privately-owned aircraft.

PREVIOUS STUDIES

Traffic and transportation problems in the Billings area have been the subject of several extensive studies in recent years. These were reviewed to assure that the fullest use was made of all available data and plans. Of particular significance were the following reports, all completed since 1954.

1954 Urban Area Traffic Study - A thorough study of traffic and parking problems in the Billings urban area was made by the Montana Highway Commission and the City of Billings in cooperation with the Bureau of Public Roads in 1954. The study presents extensive data on traffic volumes and movements as well as parking habits and demand. Recommendations were made concerning one-way streets; parking requirements; isolated intersection treatment; and arterial streets. The one-way street pattern recommended in the report was in effect when the 1961 comprehensive transportation study was made, but was abandoned shortly thereafter. A number of other improvements recommended in the report have been completed.

1957 Street Improvement Study - Morrison-Maierle, Inc., consulting engineers, submitted a report entitled "Preliminary Studies and Report on Proposed Street Improvements --Billings, Montana", in April 1957. The report deals specifically with the engineering aspects of street improvements; particularly subsurface analysis, pavement design, and storm drainage. Cost estimates are also presented for recommended street improvements.

1958 Master Development Plan - The Master Development Plan for Billings-Yellowstone County was completed by the Billings-Yellowstone City-County Planning Board in 1958. The report contains forecasts and recommendations with regard to population, land use, streets, schools and parks. A detailed discussion of problems in the central business district is also included.

1960 Railroad Grade Crossing Study - De Leuw, Cather & Company submitted a report on railroad grade crossing elimination to the Mayor and City Council in February 1960. Detailed studies were made of the most promising methods of grade crossing elimination, namely: track relocation around the southerly outskirts of Billings, partial track elevation, partial track depression, individual vehicular underpasses, and individual vehicular overhead structures. It was suggested that the city further consider the relative merits of track relocation or partial elevation of tracks through the main business area to determine economic justification.

1962 Northern Pacific Railway Report - In 1961, the Northern Pacific Railway Company entered into an agreement with the State Highway Commission and Bureau of Public Roads to study the relocation of railway facilities around the south side of Billings. The report was submitted in March 1962. The railroad analyzed various advantages and disadvantages of such relocation and presented revised estimates of cost (substantially higher than those in the De Leuw-Cather report but including some facilities not originally planned). A question was also raised concerning the status of railroad land acquired by charter.

PURPOSE OF THE REPORT

This report summarizes the results of comprehensive transportation studies made in the Billings area in August through November 1961. Data acquired in the study have been analyzed in view of present conditions and have been expanded to indicate requirements in 1981. Recommendations have been made concerning present transportation needs of the area as well as requirements over the next twenty years. These have been supplemented by estimates of the cost of each recommended improvement and have been assembled in groups by order of priority.

In order to further the usefulness of data acquired in the comprehensive transportation study, detailed summaries and tabulations are also presented in two accompanying Data Reports.* It is hoped that these data will be of value to those responsible for urban planning for many years in the future.

*-Basic Data on Parking, March 1962 and Basic Data on Traffic, February 1963.

Chapter II

SCOPE OF STUDIES

Comprehensive transportation studies made in the Billings metropolitan area fell into three general categories:

(a) Studies to determine present volumes and characteristics of travel on existing streets and highways;

(b) Studies to determine present travel habits and desires of motor vehicle drivers and passengers moving within and through the Billings area; and

(c) Studies of present parking facilities and the characteristics of demand in the central business district.

THE SURVEY AREA

It was first necessary to define the area in which a comprehensive transportation study would be made. Boundaries of the survey area were determined in the field with the cooperation of the Montana State Highway Commission and the City of Billings. The survey area, shown in Exhibit 2, was bounded on the north by a line paralleling the rimrocks and including the airport; on the east and south by the Yellowstone River; and on the west by the Billings Bench Water Association Canal and a line east of 40th Street West. The entire Billings metropolitan area, with the exception of Billings Heights and Lockwood, was included in the survey area.

The boundary of the survey area has been designated the external cordon line. The area encompassed by the external cordon line will be referred to hereinafter as the internal survey area and that outside the external cordon line will be termed the external area.

The intersection of each street or highway with the external cordon line has been defined as an external station. Numbers assigned to each external station are also shown in Exhibit 2.

For purposes of analysis, both the internal and external areas were divided into sectors, districts and zones. Boundaries and numbers of zones in the internal survey area are shown in Exhibit 2. A detailed description of external zones has been presented previously in our report entitled "Basic Data on Traffic--1961".

The central business district has been defined as the area bounded by North 23rd Street on the east; North 32nd Street on the west; and the Northern Pacific Railway tracks on the north and south. See Exhibit 3. This area includes zones 001 through 009 of the internal study area. In later analyses of parking surveys, it was found necessary to further subdivide central business district zones. Subzone numbers assigned to each block for this purpose are also shown in Exhibit 3.

STUDIES OF TRAFFIC VOLUME AND MOVEMENT

In order to determine existing volume and direction of traffic movements in the internal survey area, numerous counts were made at critical locations throughout the area. Locations at which these counts were made were often determined by requirements of various phases of the survey (i.e. the internal and external origin-destination studies as well as the parking study). Other counts were made as required to assure complete data on existing traffic.

Both manual and automatic recording counts were made of existing traffic. Manual counts included peak hour counts of through and turning traffic at 20 critical intersections and manual counts of traffic by type and direction at 49 other locations. Automatic

recording traffic counts were made for periods of at least 24 hours at approximately 250 locations through the area.

STUDIES OF PRESENT DRIVING TIME

Studies were made of present driving time on all major streets and highways in the internal survey area. These were accomplished by survey personnel driving at the average speed of all motorists on each route. A minimum of eight observations were made on those street sections where congestion existed--six at peak hours and two during off-peak periods. A minimum of three observations of present driving speed were made on all other sections of the major street system.

ORIGIN-DESTINATION STUDIES

Origin-destination studies were made in accordance with procedures set forth by the Department of Commerce, Bureau of Public Roads. These included interviews with residents of the internal survey area at their homes; interviews with truck and taxi operators; and interviews with drivers crossing the external cordon line.

Dwelling Unit Interviews

One-sixth of all dwelling units in the internal survey area were selected for inclusion in this phase of the study. Interviewers visited each location to obtain data regarding the occupants and the trips made on a weekday by each person residing there. Data were obtained from 2,867 dwelling units pertaining to 144,788 expanded trips on an average weekday in 1961.

Truck Survey

The operators of one-third of all trucks registered in the internal survey area were contacted to obtain data pertaining to each trip made by that truck on an average weekday. Data were obtained regarding the travel of 1,123 trucks and amounting to 23,644 weekday trips in 1961.

Taxi Survey

Due to the relatively small number of taxis in Billings, it was possible to obtain trip data for each taxi in operation on a weekday in 1961. These data were secured for 20 taxis making 1,814 trips on an average weekday.

External Interviews

A representative sample of drivers entering or leaving the survey area at twelve external stations were interviewed to obtain data regarding their trips. Three other external stations were omitted from the survey since traffic was too light to warrant their inclusion. Interviews were made for a 24-hour period at three stations where traffic was heaviest and for a 16-hour period at all others. A total of 18,302 drivers, or 56.1 percent of those crossing the external cordon line during the survey period, were interviewed.

PARKING STUDIES

Parking studies were confined to the previously defined central business district. These included an inventory of existing curb and off-street parking spaces (including rates charged for parking and restrictions on use); interviews--either by direct contact or return post card questionnaire--with each driver parked in the central business district on an average weekday; and additional studies of parking demand on Saturday.

Parking interviews were made between 9:00 A.M. and 6:00 P.M. on weekdays in September and October 1961 at 4,639 curb and off-street parking spaces. A total of 17,743 vehicles parked in the central business district during the study period. The drivers of 14,840 of these, or 83.6 percent of the total, were interviewed. Data regarding type of vehicle, type of parking space, and time of arrival and departure were obtained by field observation for all vehicles parked, even if the driver could not be contacted or refused to cooperate in the survey.

Chapter III

EXISTING CHARACTERISTICS OF TRAVEL

Origin-destination studies described in Chapter IV were augmented by field surveys of existing traffic movements on the present major street system. These were required to determine in detail existing areas of deficiency as well as to provide a means of ascertaining the accuracy of the expansion of data acquired in the origin-destination studies.

THE PRESENT ARTERIAL HIGHWAY SYSTEM

Arterial highways are those that provide reasonably continuous routes through the whole or a major portion of the city and generally connect with the principal highways radiating from the urban area.[1] The American Association of State Highway Officials defines five basic types of urban arterial highway:

(a) Primary Arterials
(b) Secondary Arterials
(c) Expressways
(d) Freeways
(e) Parkways

Both primary and secondary arterials have intersections at grade and direct access from abutting property. The secondary arterials are the main feeder and connecting streets between the primary arterials.

[1]"A Policy on Arterial Highways in Urban Areas". American Association of State Highway Officials, 1957. Page 68.

Expressways are divided arterial highways for through traffic with full or partial control of access and generally with grade separations at intersections. A freeway is an expressway with full control of access. A parkway is a high-type arterial which has full or partial control of access and from which commercial traffic is excluded.

The most important characteristic distinguishing an arterial highway from other urban streets is continuity. Since an arterial highway is intended to provide a route for traffic traveling through the area or between widely separated sections, it must either be continuous over a considerable distance or provide adequate connections to other arterials. Natural and man-made features which disrupt the continuity of traffic flow play an important role, therefore, in defining the urban arterial highway system.

The existing arterial highway system in the Billings internal survey area is shown in Exhibit 4. The effect of natural features such as the locations of the Yellowstone River and rimrocks together with such man-made features as the locations of railway tracks and irrigation channels are readily discernible.

There are only two crossings of the Yellowstone River in the internal survey area--Billings Boulevard and U.S. Highway 87. These arteries, therefore, form important links in the present street system. Similarly, 27th Street North and Zimmerman Trail--the only direct routes to the area north of the city on the rimrocks--assume additional importance due to this connection.

Probably the most important single feature with regard to the present Billings street system is the location of the main line tracks of the Northern Pacific Railway. The importance of the Northern Pacific in determining the location of the city has been described previously. It can be seen in Exhibit 4 that streets in the older section of the city were aligned parallel and perpendicular to the railway tracks which pass through the area in a northeast-southwest direction. As the city grew, the street pattern was changed to one of north-south and east-west streets. The importance of North 32nd and Division Streets and State Avenue, which generally form the boundary between the old street pattern and the new, is obvious. In addition, the Northern Pacific forms a barrier between the northwest and southeast sections of the city, each crossing of which forms an important link in the present street system.

The irrigation channel known as the Billings Bench Water Association Canal is the west boundary of the internal survey area from King to Broadwater Avenues. North of Grand Avenue, the B.B.W.A. Canal turns to the east and passes out of the area in the vicinity of Alkali Creek in Billings Heights. The only east-west streets which are continuous across the B.B.W.A. Canal are King, Central, Broadwater and Grand Avenues and Poly Drive. These have become important arterials, therefore, as have 5th, 13th, 17th and 24th Streets West which cross the B.B.W.A. Canal in a north-south direction.

Table 1 presents a tabulation of the general characteristics of each existing major street. Included are both primary and secondary arterials. There are no expressways, freeways or parkways in the internal survey area at the present time.

Exhibits 5 and 6 show present street width and right of way width, respectively, for each of the existing arterial highways.

PRESENT TRAFFIC VOLUMES

Manual and automatic recording traffic counts were made throughout the internal survey area to determine present traffic volume on the arterial highway system as well as the characteristics of traffic flow.

Manual classification counts were made in such a manner as to permit the determination of the directional flow of vehicles as well as the percentage of taxis, buses and various types of trucks in the traffic stream. The locations at which manual counts were made were determined largely by the requirements of various phases of the comprehensive transportation study. Such counts were required at each station on the external cordon line; at each major crossing of two screen lines bisecting the internal survey area; and on another cordon line encompassing the central business district. Manual counts were also supplemented by automatic recording counts to provide an indication of daily fluctuations in traffic.

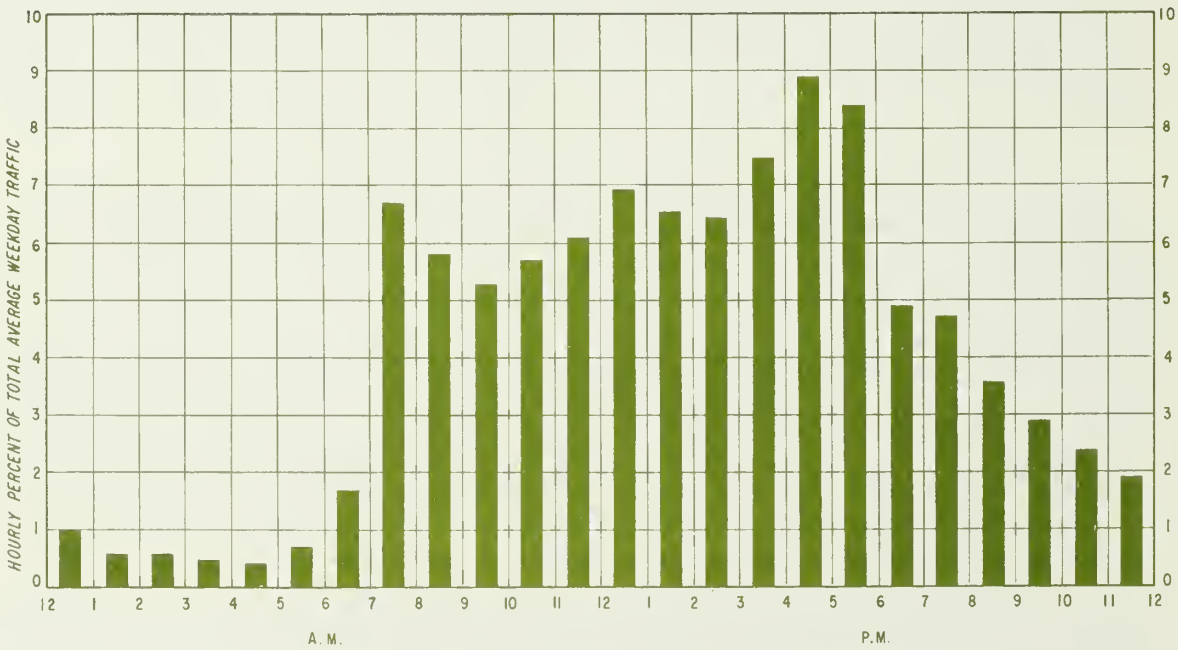
Automatic recording traffic counts were made on each segment of the arterial highway system--that is on each section of arterial between

two other arterials. The machines used were capable of recording the total number of axles crossing the detection area at 15-minute or hourly intervals. The axle counts were reduced to total vehicles based on data regarding composition of traffic flow (specifically, the percentage of vehicles with more than two axles) from nearby manual classification counts.

The 1961 average daily volume of traffic on each segment of the arterial highway system is shown graphically in Exhibit 7. Similar data are presented in tabular form in Table 2. Highest volumes of traffic were recorded on U. S. 10 and 87 East, Grand Avenue and Broadwater Avenue, where the daily volume amounted to between 8,300 and 12,400 vehicles. Montana Avenue, U. S. 87, North 27th Street and 6th Street West also carry heavy volumes of traffic.

Average hourly fluctuation of traffic flow in the internal survey area, as observed from the ground count at Screen Line "A", is shown in Figure 1. The peak hour of flow occurred between 4:00 P.M. and 5:00 P.M. and amounted to 8.9 percent of the total 24-hour volume. The morning peak hour, from 7:00 A.M. to 8:00 A.M., was 6.7 percent of daily traffic. It is also noteworthy that a mid-day peak occurred between 12:00 Noon and 1:00 P.M. The latter resulted primarily from trips made to have lunch.

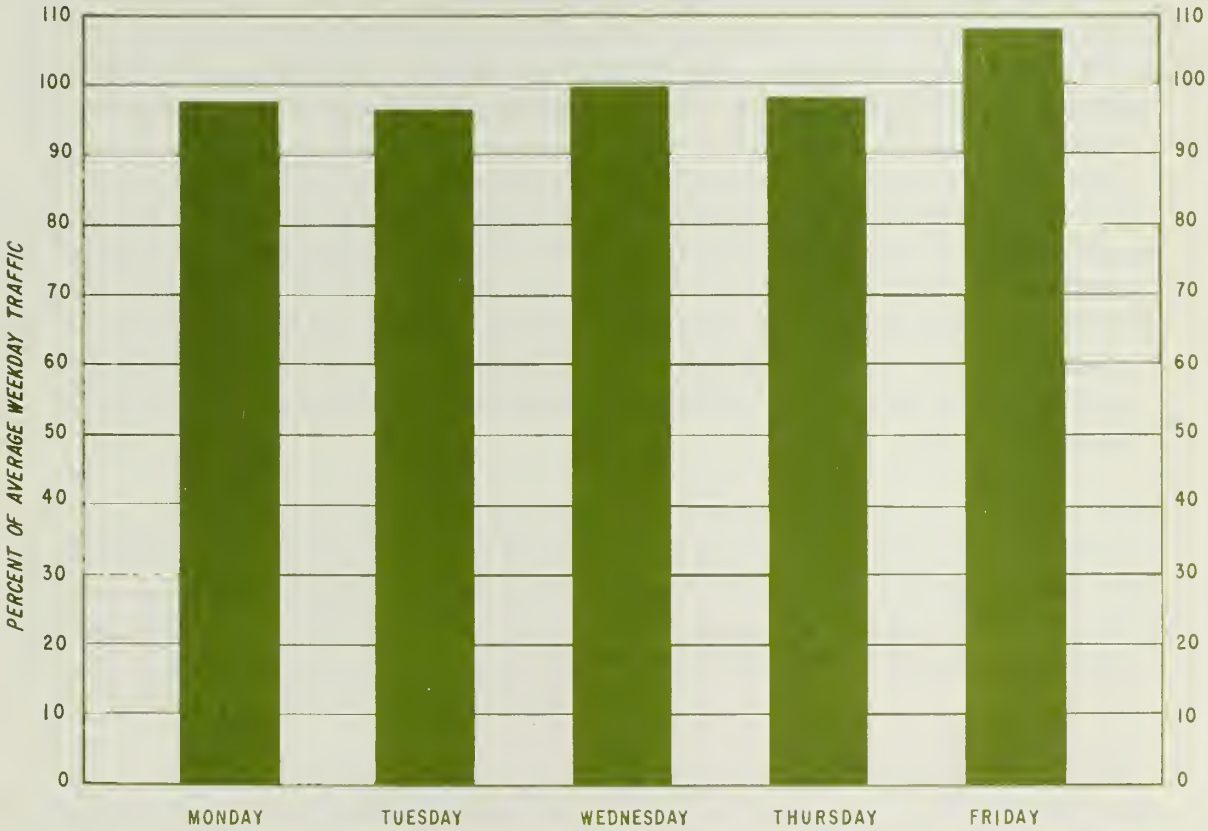
FIGURE 1



HOURLY VARIATIONS IN TRAFFIC

Figure 2 shows the average fluctuation of traffic from day to day during the week at Screen Line "A". These data are a composite of counts made from August through November 1961. It was found that traffic on Friday was the heaviest of the week. Friday traffic amounted to 108.2 percent of average daily flow. Lowest traffic volumes occurred on Tuesday, which had only 96.5 percent as much traffic as an average day.

FIGURE 2



DAILY VARIATIONS IN TRAFFIC

The composition of traffic at stations on the external cordon line as well as at various locations on internal screen lines is shown in Table 3. Passenger cars made up the vast majority of vehicles passing each point. They amounted to from 54.4 percent to 92.4 percent of the total daily traffic passing the 31 locations studied with an average of 80.5 percent.

DRIVING TIME

Studies were also made of driving times in the internal survey area both to provide an indication of present traffic delays and to be used later in assignment of traffic to the recommended street system. The studies were made by the "average car" method. Survey personnel, in a private automobile, drove with the main stream of traffic on various routes and at various times of the day. The driver was instructed to attempt to drive at the average speed of other vehicles in the vicinity, thereby maintaining a speed which averaged that of all vehicles on the road.

Exhibit 8 gives existing average driving speeds on the arterial and collector streets. These speeds vary from ten miles per hour on certain streets in the central business district to 45 miles per hour on State Highway Route 3. Average driving speeds on the majority of the major streets outside of the central business district vary between 20 and 35 miles per hour, with the lower speeds being in the areas of heavy density.

Chapter IV

ORIGIN-DESTINATION STUDIES

Studies of the volume and flow of vehicles, while adequate to uncover existing deficiencies in the street system, are not sufficient to plan long-range transportation improvements. Data regarding characteristics of travel as well as origins and destinations are required to determine the desires of motorists as distinguished from present practice. When correlated with population and land use projections, origin-destination surveys also provide a means of estimating travel patterns in future years.

SAMPLING

Ideally, it would be desirable to obtain traffic data from every resident of the survey area. In most instances, though, such a procedure would be prohibitively expensive and time consuming. It has been found, however, that data acquired from a representative sample of persons distributed geographically throughout an area can be expanded with confidence to reflect total travel.

Travel is an expression of an individual's behavior and, as such, it has the characteristics of being habitual. As a habit, it tends to be repetitive and the repetition occurs in a definite pattern. In addition, travel habits of different individuals in a metropolitan area are similar for work, shopping, recreation and other types of trips. Therefore, it is not necessary to obtain travel information from individuals for long periods of time, nor is it necessary to interview all residents of a metropolitan area in order to determine their travel habits and needs for traffic facilities.[1]

[1] "Manual of Procedures for Home Interview Traffic Study", Department of Commerce, Bureau of Public Roads, October 1954.

Dwelling Unit Sample

The sample for the internal area was specified as one-sixth of all dwelling units within the area. Sanborn maps were used to select sample dwelling units in the areas covered by the maps. Other areas were sampled by survey teams who drove through each area and recorded the address of every sixth dwelling unit for subsequent interviews. Older sections of the city, where homes had been subdivided into apartments, were also sampled in the field.

Additional dwelling units were added in the field in accordance with established survey procedures when new construction not indicated on the Sanborn maps was uncovered. Table 4 shows the computation of expansion factors for each enumeration district. These factors varied between 3.0 and 7.6. They were computed in accordance with Bureau of Public Roads standards as follows:

$$F = \frac{A - (C \times \frac{A}{B})}{B - (C + D)}$$

where:

F = Dwelling unit expansion factor.
A = Total number of addresses counted in the enumeration district.
B = Total number of samples selected in the enumeration district.
C = Sum of sample dwellings found to be vacant, demolished or used for commercial purposes only.
D = Sum of interviews missed because of contagious sickness in household, no one at home, or residents' refusal to answer questions.

Adjustments were made as follows:

$$G = F(B-C-D+E)$$

where:

G = Adjusted number of dwelling units.
E = Additional samples secured in the field because of new construction or incomplete maps.

The following table summarizes the disposition of samples selected in the dwelling unit survey together with final expansion factors and reported trips per dwelling unit.

	City of Billings	Area Outside of City Limits	Total Internal Area
Total Addresses Counted	15,975	2,189	18,164
Number of Samples Selected	2,672	368	3,040
Samples Found to be Vacant, Demolished or Used for Commercial Purposes	173	16	189
Interviews Not Completed Due to Sickness, Absence or Refusal to Cooperate	61	12	73
Additional Samples Added in Field	84	5	89
Total Interviews	2,522	345	2,867
Dwelling Unit Expansion Factor	6.12	6.17	6.13
Expanded Number of Dwellings	15,440	2,128	17,568
Expanded Number of Reported Trips	127,327	17,461	144,788
Trips Per Dwelling Unit	8.24	8.21	8.24

Truck Sample

The operators of one-third of all trucks registered in the internal survey area were selected for interviews. The sample was drawn from

truck registration lists prepared by the Montana State Highway Commission. It was found that there were 4,590 trucks registered in the internal survey area of which one-third, or 1,530, were selected for interviews. The expansion factor applied to truck interviews actually amounted to 3.98 because of interviews not completed for various reasons. Computation of the expansion factor in accordance with Bureau of Public Roads standards is illustrated below:

$$T = \frac{J-(L \times \frac{J}{K})}{K-(L+M)} = \frac{4590 - (40 \times \frac{4590}{1530})}{1530 - (40+367)} = 3.98$$

where:

T = Truck trip expansion factor.
J = Total number of trucks registered in the internal survey area.
K = Total number of samples selected.
L = Sum of sample trucks found to be junked, wrecked, out of service for repairs, or addresses of owners found to be outside of the internal survey area.

M = Sum of truck interviews not completed because the truck was registered in the internal survey area but used continuously elsewhere; the truck was transferred to a new owner residing outside of the survey area; the owner could not be found to obtain travel information; or the owner refused to answer questions.

Taxi Sample

Due to the relatively small number of taxicabs operated in the internal survey area, all taxi operators were interviewed. Data were obtained regarding the travel of 20 taxis in the internal survey area amounting to 1,814 trips or an average of 90.7 trips per taxi on a weekday.

External Cordon Interviews

Roadside interviews were made at 12 of 15 external stations on the cordon line encompassing the internal survey area. See Exhibit 2. Traffic at the remaining three stations (Numbers 7, 10 and 15) was found to be too light to warrant interviewing. Interviews were made over a 24-hour period at the three heaviest traveled stations--Numbers 8, 12 and 14. The remaining nine stations were surveyed over a 16-hour period from 6:00 A.M. to 10:00 P.M.

External sampling and interviewing were done simultaneously by selection of the vehicles passing through the external interview station. As many interviews as possible were made without unduly disrupting traffic flow. At least 30 percent of the total traffic passing through each external station during each hour of the survey was stopped for interviews. Greater samples were obtained in off-peak hours. The following table shows the disposition of the external interview sample by various stations on the external cordon line:

Station Number	Average Weekday Traffic (Vehicles/Day)	Usable Interviews	Percent of Daily Traffic Interviewed
1	968	605	62.5
2	1,010	705	69.8
3	1,030	696	67.6
4	299	245	81.9
5	913	520	57.0
6	887	457	51.5
8	5,513	3,719	67.4
9	853	635	74.4
11	779	626	80.4
12	7,216	4,188	58.0
13	1,196	677	56.6
14	11,944	5,229	43.8
Total	32,608	18,302	56.1

COLLECTION OF DATA

All origin-destination studies were completed in the three-month period from August through October 1961. Dwelling unit samples interviewed were distributed throughout the period as shown below:

	Number of Interviews	Percent of Total
August	843	29.4
September	1,232	43.0
October	792	27.6
Total	2,867	100.0

Samples interviewed in each month were distributed geographically throughout the area. This was done to compensate for possible variations in trip production from month to month.

Truck interview samples were received from the Montana State Highway Commission in September and interviewing began immediately thereafter. Truck interviews were completed by the end of October.

Taxi interviews were all made in October 1961.

At the request of the Montana State Highway Commission, all external cordon interviews were made during August 1961.

A detailed description of survey procedures and information obtained in each phase of the origin-destination study will be found in our accompanying report entitled "Basic Data on Traffic--1961".

TABULATION OF DATA

Data from the origin-destination interview studies were coded and punched into statistical tabulating cards for further analysis.

Factors were computed for each census enumeration district to expand the data obtained in each dwelling unit interview. Dwelling unit information was punched into a deck of 2,867 cards--one for each dwelling unit at which interviews were completed. These were designated Cards Number 1. One card was also punched for each trip recorded in the home-interview study--a total of 23,922 cards (Card Number 2). Summary cards were later punched for the total vehicular and person trips between each combination of zones in the internal survey area. There were 9,418 internal summary cards (Cards Number 6).

Expansion factors were computed on an hourly basis for the roadside interviews at each external station. Factors were also derived to expand data obtained at 16-hour stations to the 24-hour total. Interview data on through trips which pass through two external stations are theoretically obtained in duplicate. To compensate for this duplication, expansion factors for such trips were halved. External interview data were punched into 18,302 cards (Cards Number 3)--one for each driver interviewed at the external cordon line. External interview data were also punched into 2,211 summary cards (Cards Number 8), one for each combination of zone-to-station or station-to-station trips.

Truck and taxi interview data were punched into Cards Number 4 and 5, respectively. There were 4,085 truck trip cards and 1,814 taxi trip cards. Data from these cards were also punched into the internal summary cards (Cards Number 6).

Standard tabulations specified by the Bureau of Public Roads in the "Manual of Procedures for Home Interview Traffic Study" were prepared and are presented in our report, "Basic Data on Traffic--1961".

SCREEN LINE COMPARISONS

Two screen lines were designated to provide a check of the completeness of expanded survey data. See Exhibit 2. Manual classification and automatic recording counts were made at every crossing of each screen line during the course of the studies. Ground counts were later checked against expanded trip data from the origin-destination studies.

Screen line comparisons indicated that origin-destination trip reports should be adjusted upward to provide a more valid comparison. A number of possible adjustments were tried before it was agreed that an expansion factor of 1.6 should be applied to non-work auto driver trips made by residents of the internal survey area. A factor of 1.4 was also applied to internal truck trips.

A detailed explanation of screen line adjustments as well as tables and charts showing the comparisons is presented in the Traffic Data Report.

Chapter V

1961 TRAVEL CHARACTERISTICS AND DESIRES

The origin-destination surveys provided important data regarding present characteristics and patterns of travel in the Billings urban area. Data on dwelling unit statistics, purpose of trip, mode of travel and the pattern of travel from zone to zone as well as for external and through trips are described in this section of the report.

CHARACTERISTICS

Dwelling Unit Statistics

The following table summarizes pertinent data regarding dwelling unit characteristics obtained in the home interview studies:

	Number[1]	Per Dwelling
Dwelling Units	17,568	-
Passenger Cars Owned	22,734	1.29
Total Persons	58,718	3.34
Persons Over 5 Years of Age	50,905	2.90
Persons Over 5 Years of Age Making Trips	33,214	1.89
Total Number of Trips[2]	144,788	8.24
Total Number of Trips[3]	204,527	11.64

[1]Expanded number from dwelling unit survey.

[2]Total number of trips not expanded on the basis of screen line comparisons.

[3]Internal auto driver and auto passenger trips expanded on the basis of screen line comparisons. Internal to external auto driver trips shown in Table C-2 of the Basic Data Report were obtained in the external survey while this total reflects the number of such trips reported in the home interview survey.

Total persons residing in the internal survey area was found to be 61,414 in the 1960 census. This compares with expanded internal area population of 58,718 from the dwelling unit survey, or a difference of 4.6 percent.

Passenger car ownership amounted to 1.29 per dwelling unit or 387 per 1,000 persons residing in the internal survey area. Expressed in another way, vehicle ownership in 1961 amounted to 2.58 persons per passenger vehicle.

It was found that 65.2 percent of persons over five years of age reported trips on an average weekday. A total of 33,214 persons over five years of age reported 144,788 trips for an average of 4.36 trips per day for each person who traveled on an average weekday. Total daily trips per capita amounted to 2.47 trips per day.

A tabulation of 1961 dwelling unit statistics for each census enumeration district in the internal survey area is shown in Table B-1 of the Basic Data Report.

Purpose of Trip

Ten trip purpose categories were recorded in the origin-destination surveys: these were home, work, business, medical-dental, school, social-recreation, change travel mode, eat meal, shopping and serve passenger.

In the home interview study, purpose of trip was recorded at both origin and destination. Table 5 shows a breakdown of the expanded number of trips by purpose at destination from the home interview survey for three basic groupings of mode of travel. It will be noted that the largest number of trips for any purpose was 35.6 percent of the total to "home". In practice, however, "home" does not represent a genuine trip purpose. It may be considered, instead, as return travel from the purpose which motivated the trip. ("Home" purpose does not equal one-half of all trips due primarily to a large number of trips with two or more stops before completing the circuit.) In Table 6, trips to "home" have been redistributed by purpose at origin thereby revealing a more nearly representative indication of actual trip motivation. The largest number of person trips for a single

purpose were those making social-recreation trips (26.1 percent). Shopping trips were next in importance (21.3 percent), followed by work trips (17.9 percent). The fact that person trips for purposes of social-recreation and shopping were greater than those for work is unusual when compared with the results of similar studies made in other cities, and warrants future study by the local planning agency. The largest number of drivers for a single purpose were those making work trips. The average occupancy of internal work trips was 1.2 compared with 1.9 for social-recreation and shopping trips. See Table B-3 of the Basic Data Report.

Table 7 shows a summary of auto driver trips by purpose at the external cordon line. Vehicle occupancy is also shown by purpose of trip. Social-recreation trips were also predominant at the external cordon, particularly insofar as through trips were concerned. The latter, amounting to 63.6 percent of all through trips, were primarily tourist or vacation travel.

Of the local trips at the external cordon, 32.2 percent were for social-recreation; 28.0 percent were for work; 22.1 percent were for business; and 8.3 percent were for shopping. All other purposes amounted to only 9.4 percent of total local trips.

Passenger Car Occupancy

Passenger car occupancy was determined in both the internal and external surveys. Tabulations of passenger car occupancy by purpose of trip from the internal and external surveys are shown in Tables B-3 and B-3a, respectively, of the Basic Data Report.

Average passenger car occupancy for all purposes from the internal survey was 1.8 persons per vehicle. This compares with average passenger car occupancy of 2.1 persons per vehicle from the external survey.

Trips to work showed lowest passenger car occupancy amounting to 1.2 persons per vehicle in the internal survey and 1.4 persons per vehicle in the external survey. Highest occupancy was to serve passenger in the internal survey and for change mode of travel, social-recreation and shopping trips in the external survey.

Mode of Travel

A total of 274,201 person trips were made within, to or from, and through the Billings urban area on a typical weekday in 1961. See Table 8. Approximately 97 percent of all trips began or ended within the internal survey area.

Of total person trips on an average weekday, approximately two-thirds were made by drivers of either autos, trucks or taxis. The remaining one-third were vehicle passengers. Transit, taxi, truck and school bus passengers together amounted to only 1.4 percent of total daily travel.

1961 Travel Desires

Trips reported in the origin-destination survey were analyzed to determine the present desires of motorists. These are portrayed on desire line charts which afford the opportunity to evaluate trip desires without regard to the existing street system. The desire line charts were prepared on the basis of district-to-district rather than zone-to-zone traffic movements since the number of small zones involved would have produced a pattern too complex to analyze.

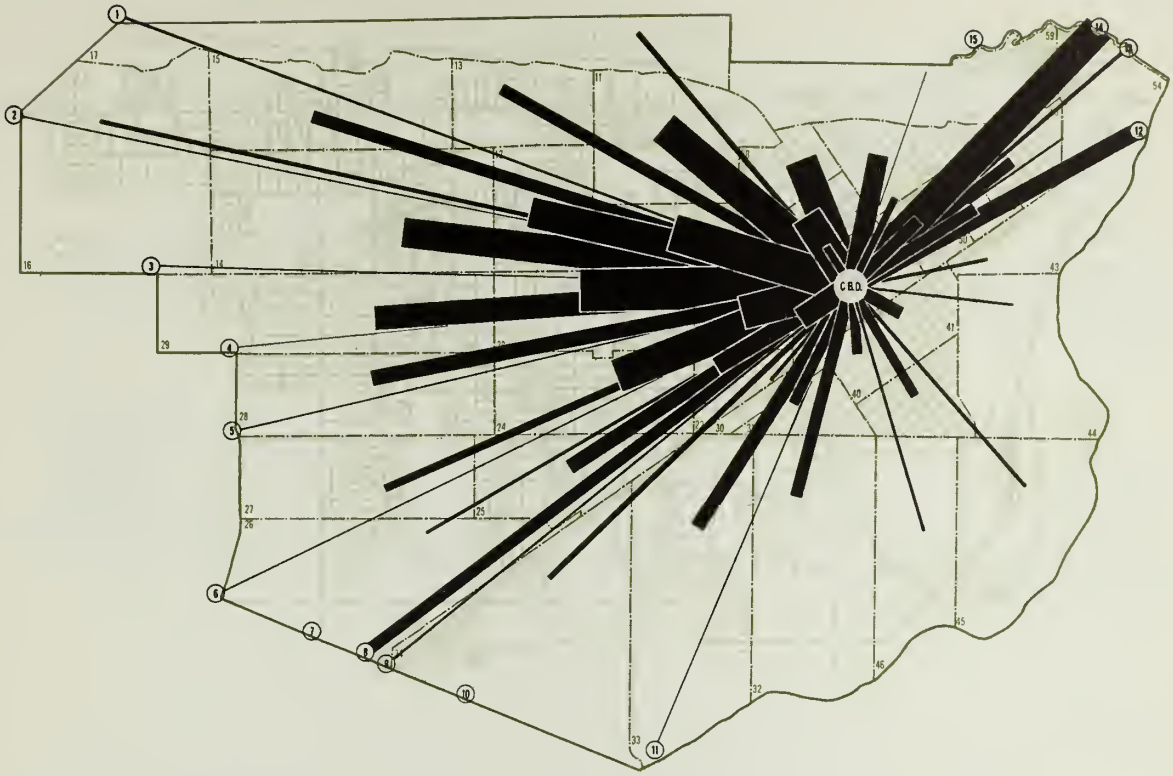
The desire line charts show each trip or group of trips as a band--the width of which is proportional to number of trips--extending from the centroid of the district of origin (or external station) to the centroid of the district of destination (or external station).

DESIRES

Travel To and From the C.B.D.

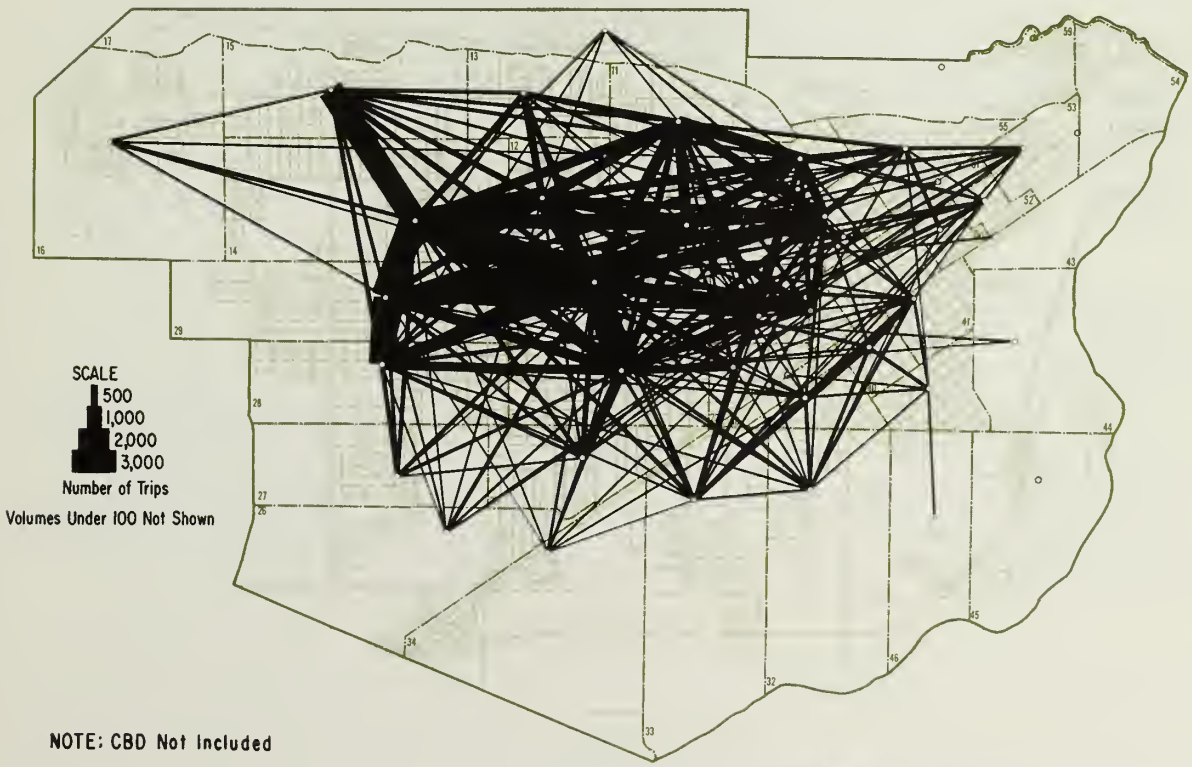
Figure 3 shows 1961 trip desires for drivers traveling to and from the C.B.D. Of the total 184,014 vehicle trips on an average weekday, 45,338, or 24.6 percent of the total vehicles, had origins or destinations in the C.B.D. These were made up of 40,401 trips to or from the internal area and 4,937 trips with either an origin or

FIGURE 3



DESIRE LINES OF TRAVEL TO AND FROM C. B. D.- 1961

FIGURE 4



NOTE: CBD Not Included

DESIRE LINES OF TRAVEL BETWEEN INTERNAL DISTRICTS — 1961

destination outside of the external cordon line. Of all trips between the internal and external area, 18.6 percent either originated or ended in the C.B.D. (A total of 4,883 vehicle trips had both origin and destination in the C.B.D. but are not shown in Figure 3.

Desire lines of travel to and from the C.B.D. clearly indicate heaviest desires from areas directly west of the business district. Travel desires between the C.B.D. and Billings Heights and Lockwood regions are also evident. There appears to be very little travel desire between the C.B.D. and the area south of the Northern Pacific Railway tracks (Screen Line A).

Travel Between Internal Districts

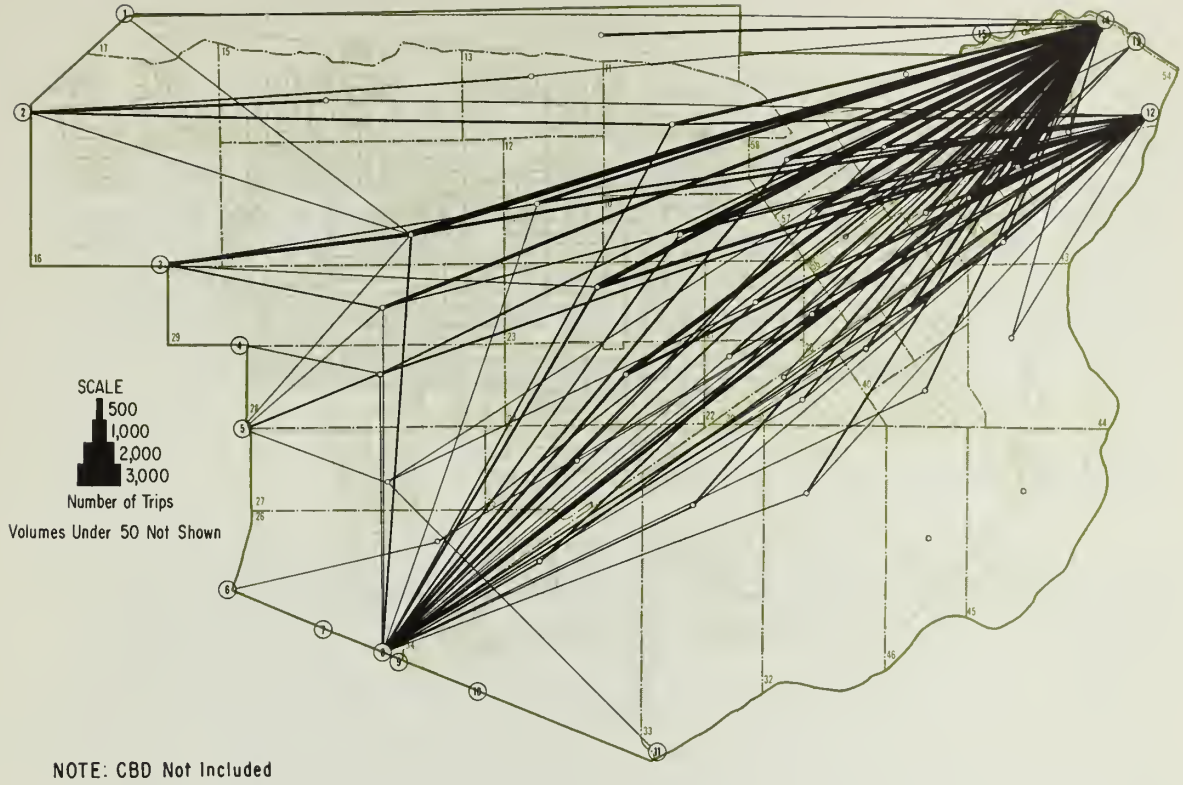
A total of 109,053 vehicle trips, or 70.6 percent of those determined from the internal survey, had both origins and destinations within the internal area but outside of the C.B.D. The pattern of desires for these trips is shown in Figure 4.

The heaviest concentration of trip desires between internal zones is in an east-west direction in the vicinity of Grand Avenue. Of the trips shown in Figure 4, 11,596 trips, or approximately 10.6 percent, had an origin or a destination in the large shopping center shown as District 14. The shopping center of District 23 had 11,573 trips which is an additional 10.6 percent of the total shown in the figure.

Travel Between External Stations and Internal Districts

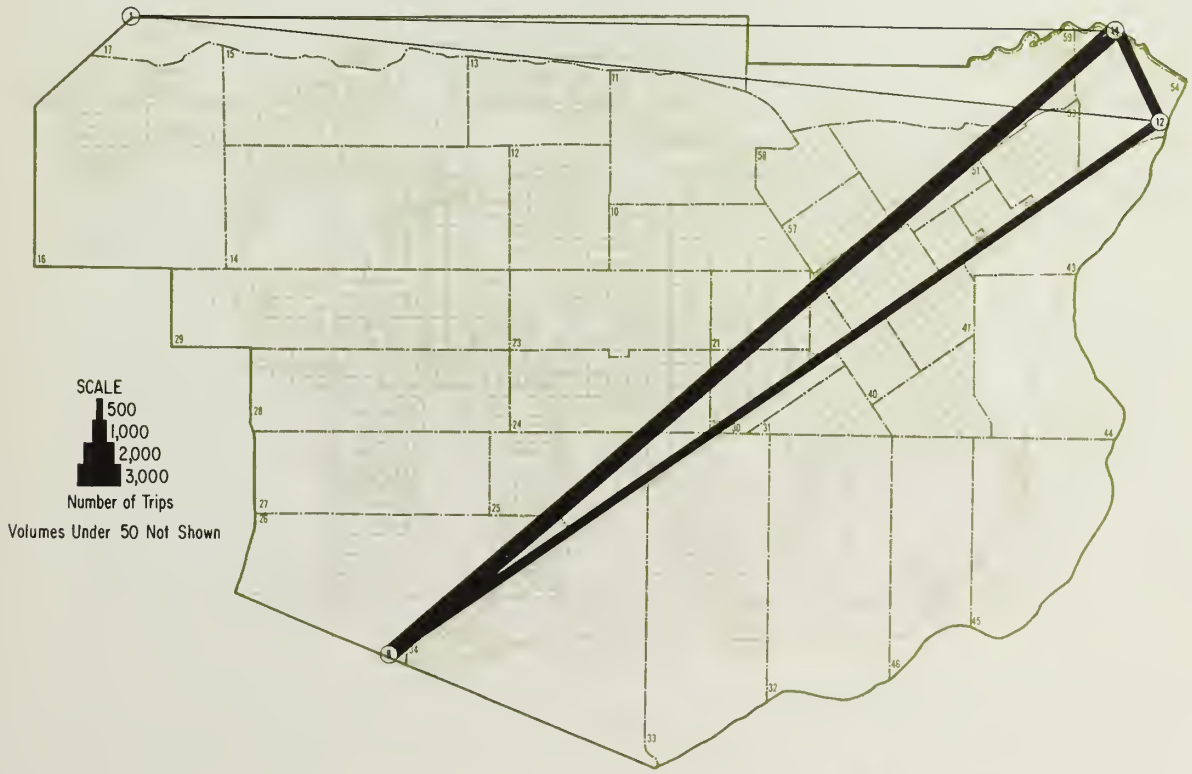
There were 26,539 daily vehicle trips between external stations and internal districts. Of these, 4,937, or 18.6 percent of the total, were trips to and from the C.B.D., the desire lines of which are shown in Figure 3. Desire lines of travel between external stations and internal districts other than the C.B.D. are shown in Figure 5.

FIGURE 5



DESIRE LINES OF TRAVEL BETWEEN EXTERNAL STATIONS AND INTERNAL DISTRICTS -1961

FIGURE 6

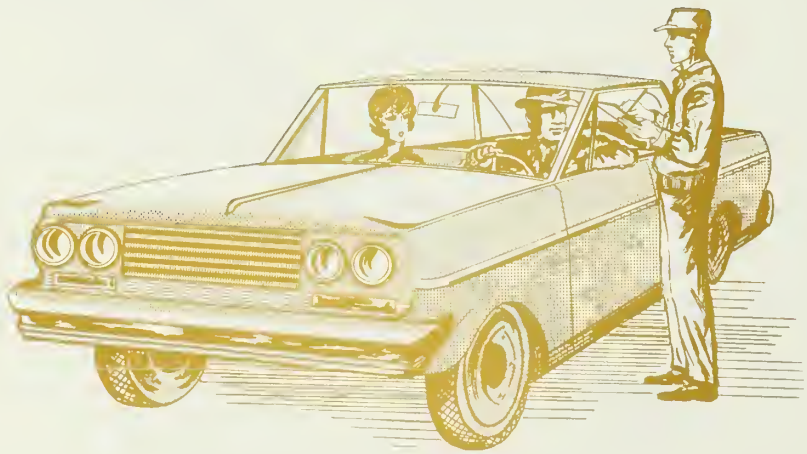


DESIRE LINES OF TRAVEL BETWEEN EXTERNAL STATIONS — 1961

Desire lines of travel between external stations and internal districts are generally aligned parallel to the route of the Northern Pacific Railway. Travel desires in the north-south direction are negligible. The heavy influence of the three major routes of entry to the Billings urban area (Interstate Highway 90 on the west and U.S. Highways 10 and 87 on the east) is readily discernible.

Through Travel

Desire lines of travel through the Billings urban area--that is, trips with no significant stop in the internal survey area--are shown in Figure 6. The only through bands of any significance are those along the major U.S. Highway routes. Of all through trips, 2,542, or 81.0 percent of the total, were found to be between a combination of external stations 8, 12 and 14--the points where U.S. Highways cross the external cordon line. The heaviest single traffic demand was on U.S. Highway 10 (Stations 8 and 14). The latter amounted to 1,160 vehicular trips on an average weekday, or 37.0 percent of all through trips.



Chapter VI

ESTIMATES OF FUTURE TRAFFIC

This section of the report presents estimates of traffic for the design year 1981 in the Billings metropolitan area. The estimates are based on present travel patterns determined through the comprehensive transportation survey, together with forecasts of future population and land use. Trip expansion factors were developed for each zone in the internal survey area as well as for each external station. Future travel desires were then determined and subsequently assigned to the existing system of arterial highways in order to uncover areas of future deficiency.

POPULATION FORECASTS

Estimates have been made of population of both the Billings urban area and Yellowstone County in the years 1965, 1970, 1975 and 1981.

Previous estimates made by others were reviewed prior to development of the forecasts described in this section of the report. It was apparent that several population estimates made in the period from 1950 to 1960 were overly optimistic. While the 1960 census showed an increase of 21,017 persons, or 66 percent, in Billings city population, the growth was entirely in areas annexed to the city since the previous census. Population within the city limits, as they existed in 1950, actually decreased by 2,848 persons, or 9.0 percent, in the ten-year period.

In view of the foregoing, entirely new population projections were made for an area which could easily be compared with zones

established in the origin-destination survey. The Billings urban area has been defined as 1960 census enumeration districts 1 through 54 in Yellowstone County with the exception of district 49-S. The boundaries of census enumeration districts are shown in Exhibit 9. A small portion of the "Billings West" district is also included. The area approximately comprises the entire internal survey area together with the Billings Bench and Lockwood regions. Population of the Billings urban area in 1960 was 66,135 persons or 83.6 percent of the Yellowstone County population of 79,016.

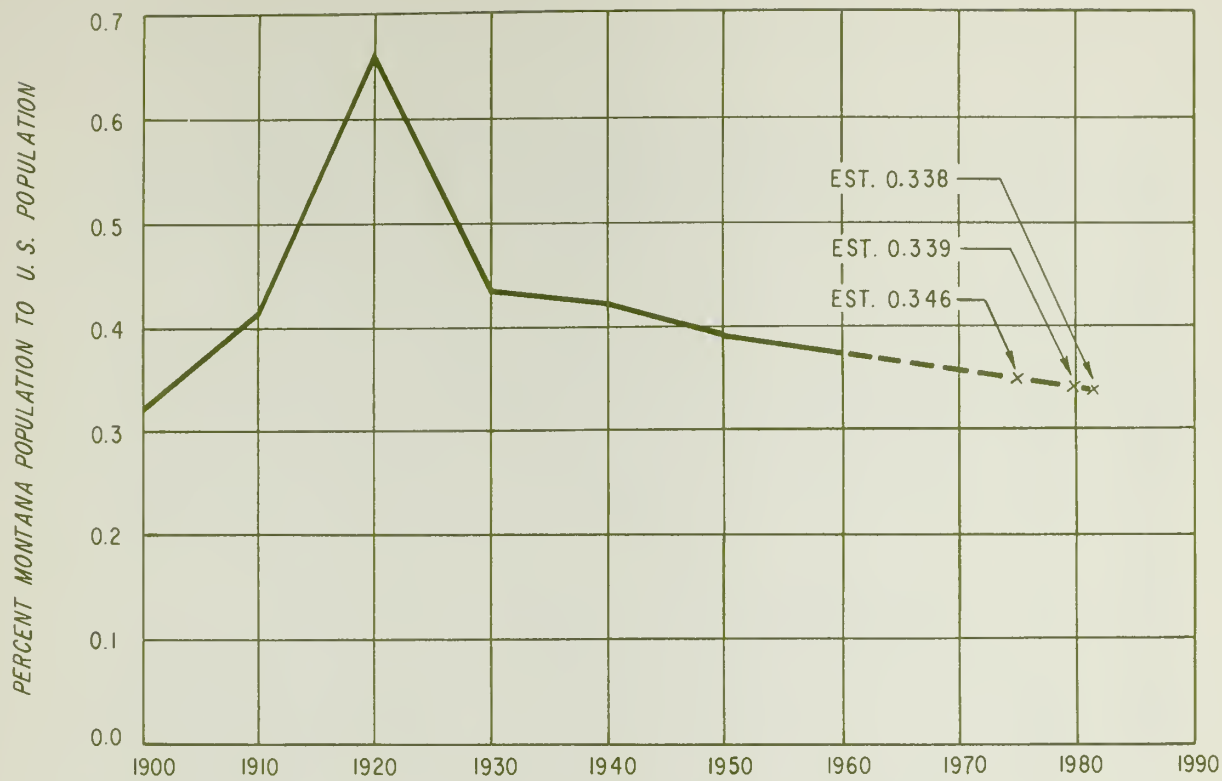
The "ratio" method was used for estimating population in 1981 and intermediate years. This involved projecting United States, Montana and Yellowstone County population, as well as the trends in relationship between each. Table 9 summarizes these estimates. Population forecasts for the United States were obtained from Statistical Abstract of the United States - 1958, published by the U. S. Department of Commerce, Bureau of Census. Estimates of Montana population to 1970 were also obtained from a U. S. Department of Commerce publication entitled Current Population Reports, Series P-25, Number 160. Both publications provided four alternative estimates based on different projections of fertility and mortality rates, migration, etc. The median of the four was used in estimating United States population in 1981. In the Montana forecast, which was made in 1957, the highest estimate most nearly reflected actual 1960 population. This curve was utilized, therefore, to derive the estimated State population in 1965 and 1970.

Montana's share of the total population of the United States has been decreasing since 1920. This has probably resulted from the spectacular growth of the nation's larger metropolises during this period. The trend in this relationship for the period from 1950 to 1960 was projected to 1981 in order to estimate Montana population in that year. See Figure 7.

Figure 8 shows past and projected population growth for both the United States and Montana.

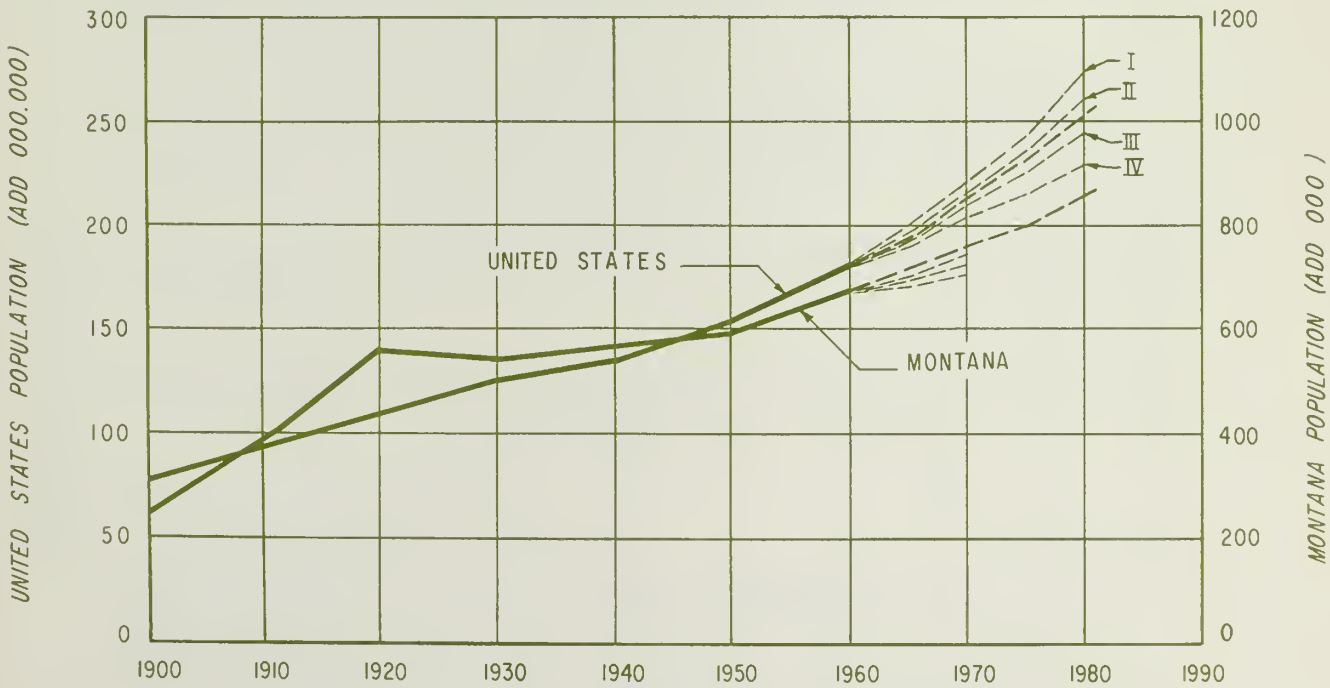
Since 1920, the population of Yellowstone County has grown at a more rapid pace than that of the State. County population amounted to 11.71 percent of the State's in 1960, compared with 5.39 percent in 1920. The 20-year trend from 1940 to 1960 was projected for an additional 21 years to arrive at the estimated relationship between the

FIGURE 7



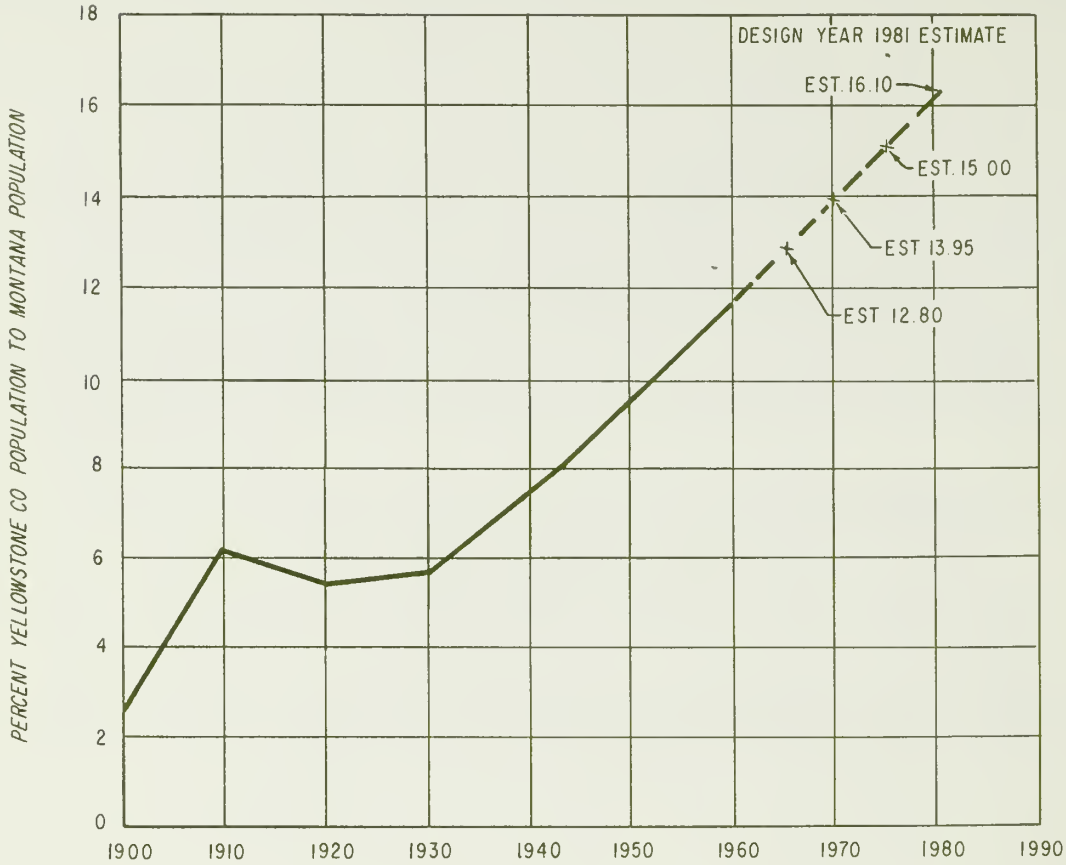
RELATIONSHIP BETWEEN MONTANA AND UNITED STATES POPULATION

FIGURE 8



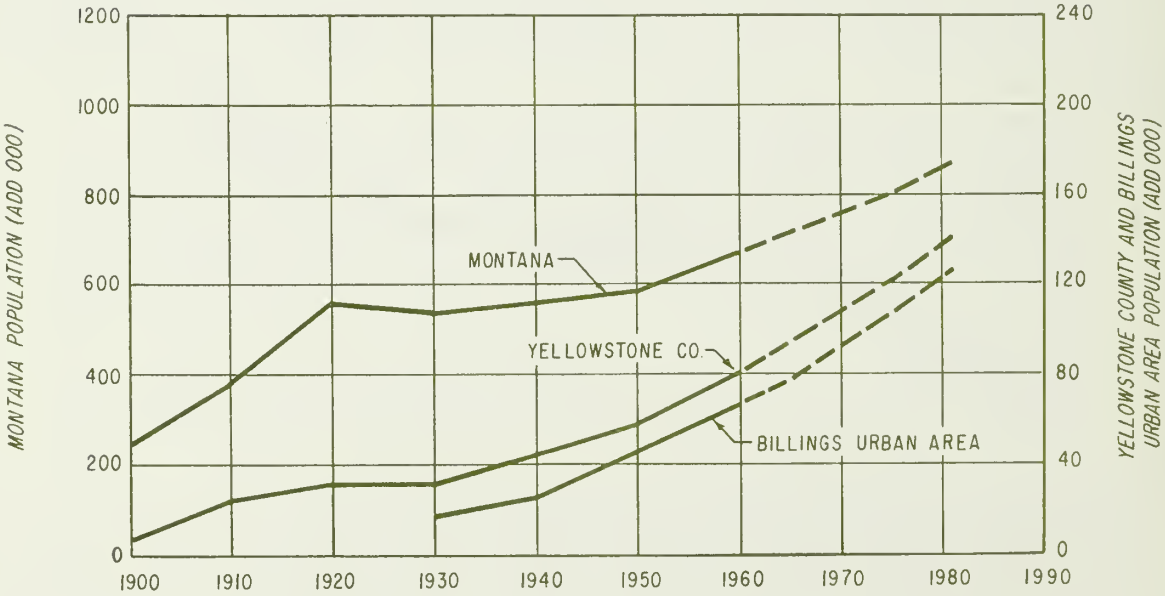
POPULATION TRENDS - UNITED STATES AND MONTANA

FIGURE 9



RELATIONSHIP BETWEEN YELLOWSTONE COUNTY AND MONTANA POPULATION

FIGURE 10



POPULATION TRENDS - MONTANA, YELLOWSTONE COUNTY AND BILLINGS URBAN AREA

populations of Yellowstone County and Montana in 1981. See Figure 9. It has been estimated that the population of Yellowstone County will be 140,000 persons in 1981.

Table 9 summarizes past and projected population trends for Yellowstone County and the Billings urban area from 1930 through 1981. The same data are shown graphically in Figure 10. The relationship between urban area and County population was analyzed in a manner similar to that described previously. It has been estimated that, in 1981, population of the Billings urban area will be 125,000 persons or 89.3 percent of the total in the County.

Population within the internal survey area was approximately 61,400 persons in 1960. It is apparent that the entire projected urban area growth could not occur within this area because of physical limitations. It has been estimated from present trends in population density and projected future land use (described later) that population of the internal survey area will be approximately 102,000 persons in 1981. The remaining 23,000 persons residing in the urban area will be absorbed in the Bench and Lockwood regions, as well as in the area immediately to the west of Billings. See Table 10.

Exhibit 9 shows a comparison of population reported in the 1960 census with 1981 population estimates for each census enumeration district in the internal survey area. Areas in which greatest population growth is anticipated are readily discernible in the exhibit. The same information is presented in tabular form in Table 11.

PROJECTED FUTURE LAND USE

Projections have been made of 1981 generalized land use in the Billings metropolitan area. Generalized land use in the internal survey area in 1957 is shown in Exhibit 10. Estimated 1981 generalized land use in the internal survey area is shown in Exhibit 11. It is important to note that each plan has been specifically designated as showing generalized land use. Generalized

land use is defined as the predominant utilization of land in each block or other sub-area of the total internal survey area. The designation of land use in one section of the area as residential, commercial, industrial, etc., does not imply that other land use might not also be found in that area, but only that the designated land use is predominant. For example, an area indicated as commercial or industrial may still have a limited residential population. The converse, of course, also applies.

Land use projections to 1981 were based on existing trends, planned future developments, and a general appraisal of the needs of the area in 1981. With regard to future residential land use, existing trends in location of new residences as well as type and size of residential units were projected. Predominant growth of residential areas, for example, has been to the west. It was assumed this trend would continue. Similarly, future density of residential population was based on trends in residential density in nearby or similar areas. Trends in development of commercial areas were also extended. These are particularly evident in comparing commercial areas on Grand Avenue in 1957 and 1981. See Exhibits 10 and 11. It has been estimated that the existing nucleus of a strip commercial development will consolidate and expand by 1981. Similar consolidation of commercial and industrial areas within or near the central business district has also been forecast.

Future developments were also taken into account in the land use projection in instances wherein definite plans had been proposed or formulated for a specific project. Some of these included new parks, schools and government buildings; Interstate Highway 90; airport expansion; and anticipated future construction and expansion in the Northern Pacific industrial site.

Exhibit 11 is not intended to indicate recommendations for future zoning or planning. Moreover, it is not claimed that the projected land use plan even represents good concepts in city planning. In view of what has happened before, however, it is believed that the forecasts of future land use represent a realistic appraisal of future growth patterns in sufficient detail for the purposes of traffic projections.

Since distribution of population throughout the area is a function of density of residential development as well as of physical limitations imposed by the size of each area, the 1981 generalized land use plan played an important role in estimating 1981 population in each census enumeration district. Population estimates have been described in the foregoing section of the report. It would be appropriate at this point, however, to elaborate on some of the assumptions and procedures which entered into the analysis of population distribution.

Predominant land use was divided into four major categories--commercial, industrial, residential and public or semi-public. Residential land area was compared with population to determine two indices--persons per gross residential acre and persons per net residential acre. The difference between the two indices is that gross residential acres include all land area which is presently or potentially residential while net residential acres include only the area upon which dwelling units are constructed.[1] Vacant residential lots are included in the computation of gross residential acreage, but not when computing net area. Population per gross residential acre is an indication of the extent to which an area has been developed while population per net residential acre is an indication of the intensity of development. The two indices would be identical in fully developed areas, but would differ widely in areas which are sparsely settled.

Table 11 summarizes projections of residential development and population in each census enumeration district. Present and estimated future area devoted to various categories of land use in each zone of the internal survey area is shown in Table 11-A.

Two different approaches were necessary in analyzing future population distribution. One applied to areas which are presently almost fully developed and the other applied to areas containing a sizable percentage of undeveloped land.

[1]This definition of gross and net residential acres differs from that commonly used by geographers and city planners. Area devoted to streets and alleys is included in the computation of both gross and net area.

In areas which are presently almost fully developed, the area devoted to residential use was computed. Area devoted to streets and alleys was prorated to each category of land use. Vacant lots were assigned land use similar to surrounding developments. The 1960 population was then compared with existing gross and net residential area to determine present indices of development. In most older sections of the city, indices of persons per gross residential acre and persons per net residential acre were nearly equal.

Future development of additional commercial or industrial facilities in areas which are almost fully built-up at the present time will be, in most instances, at the expense of existing residential land. It has been estimated, therefore, that the residential area in a number of close-in districts will decrease from 1960 to 1981. (Decreases in residential land area have also been forecast in several districts further removed from the core of the city. These resulted primarily from estimated expansion of strip commercial development along several major streets.) Population projections to 1981 were made by applying the anticipated index of persons per net residential acre to the number of residential acres available in 1981. The index of persons per net residential acre is expected to increase in some close-in areas due to further development of multi-family dwelling units--either by new construction or conversion of large old homes to apartments.

In areas which are sparsely settled at the present time, a different approach was used. Gross residential area was computed by subtracting areas presently or ultimately required for commercial, industrial, public or semi-public uses from the total available land area. Area devoted to or required for streets and alleys was also prorated among each type of land use. Gross residential area would remain the same from 1960 to 1981, therefore, since requirements for other uses had also been estimated in its original computation. Population in 1981 was computed on the basis of the residential area expected to be developed and the anticipated density of population in the developed area.

It can be seen in Table 11 that total residential land area within the present city limits of Billings is expected to be almost

fully developed by 1981 (95.2 percent). Density of population in sections of the internal survey area not within the present city limits, it is anticipated, will be considerably lower.

Estimated population growth from 1960 to 1981 in each census enumeration district is shown graphically in Exhibit 9.

EXPANSION OF TRAFFIC DATA

Traffic patterns in 1981 were determined through expansion of data acquired in the 1961 origin-destination survey. This required forecasting the future number of trip ends in each zone on the basis of known trips in 1961 together with projections of future land use and population.

Separate expansion factors were derived for trips destined to the following general types of land use in each zone:

1. Residential

2. Manufacturing and Non-Manufacturing Industry

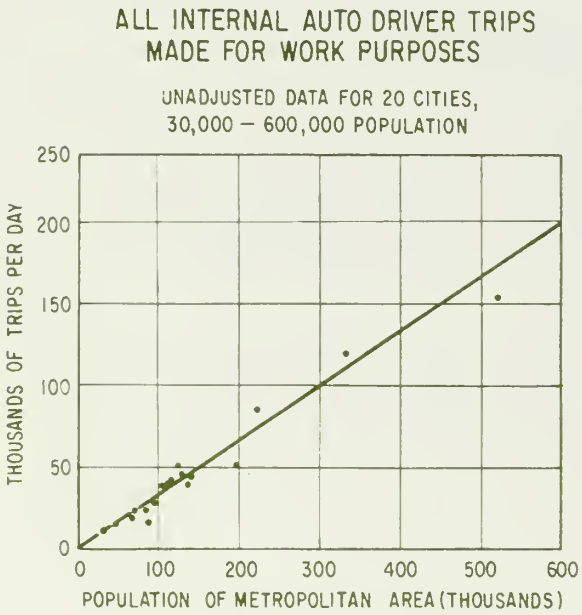
3. Services, Storage and Commercial

4. Public and Quasi-Public Buildings and Open Space

Trips destined to each of these categories of land use in each zone in 1961 are shown in Exhibit 12.

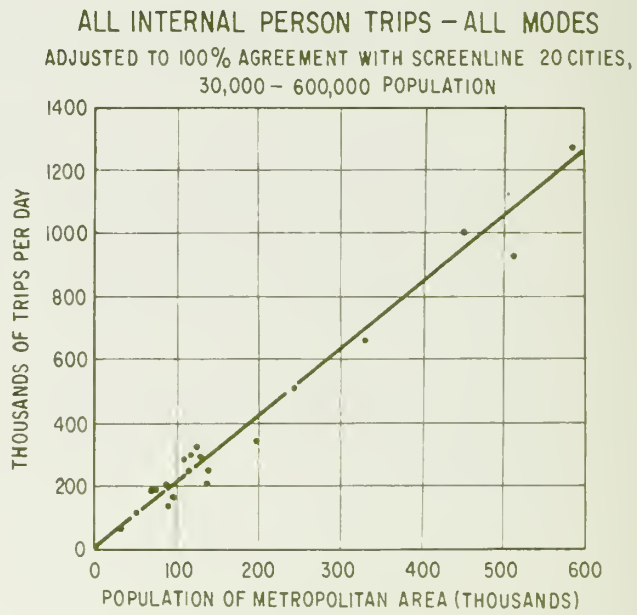
Previous studies[1,2] have indicated that daily trip production per person will remain nearly constant over a number of years. One study[3] concluded that "resident trip production in any desired area for which prior surveys are available can be forecast (with reasonable accuracy) by multiplying trips per person for the base year by population of the area for any future year." (Parentheses ours.) Other studies (See Figures 11 and 12) have also shown the relationship between population size and increased trip generation.

FIGURE 11



Source: Highway Research Board Bulletin 119, pg. 56

FIGURE 12



Source: Highway Research Board Bulletin 119, pg. 55

Expansion factors for trips destined to residential land use, therefore, were determined primarily by forecasts of population growth (or decline) in each zone between 1961 and 1981. It has been estimated that the number of persons living in the internal survey area will increase by 66 percent in the period from 1961 to 1981.

[1]Silver, "Trends in Travel--Washington, D.C.", Highway Research Board Bulletin 224, 1959, pp. 1-40.

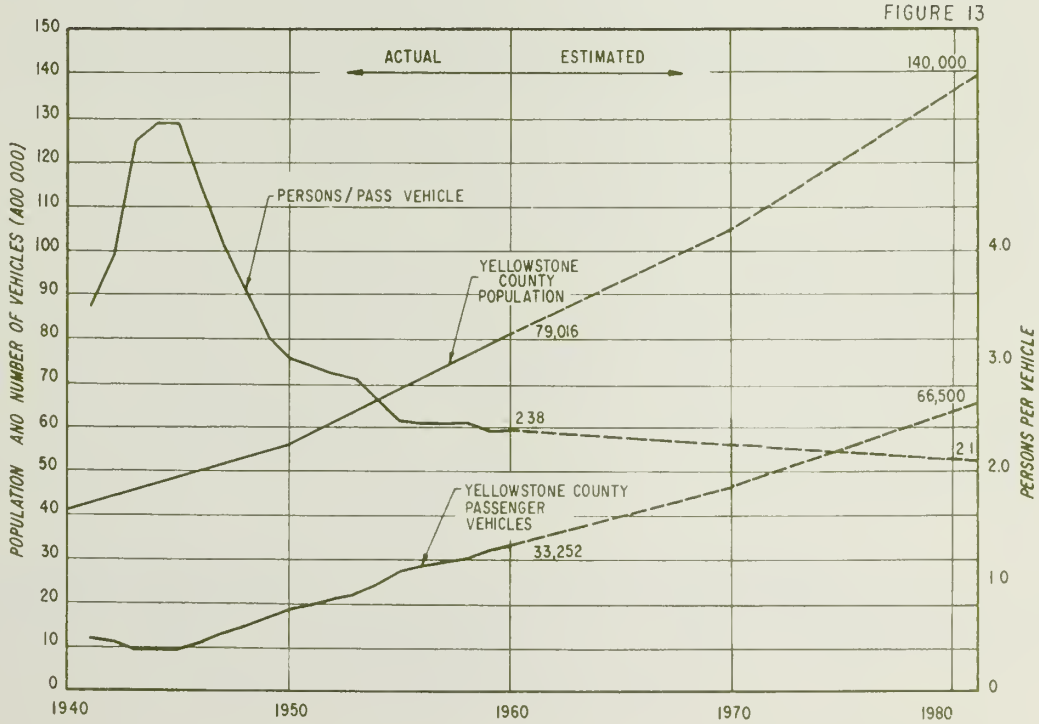
[2]Sharpe, G.B., et al, "Factors Affecting Trip Generation of Residential Land-Use Areas", Highway Research Board Bulletin 203, 1958, pp. 1-40.

[3]Ibid., p. 34.

It has also been predicted that passenger vehicle ownership in Yellowstone County will increase from 420 vehicles per 1000 persons in 1961 to 475 per 1000 persons in 1981--an increase of 13 percent in the 20-year period. This amounts to a projected ratio of 2.1 persons per passenger vehicle in 1981, as shown in Figure 13. Vehicle ownership has been found to be another important factor in trip generation. Figures 11 and 14 give an indication of how the inclusion of estimates of vehicle ownership in the estimate of vehicle trips increases the accuracy of the forecast. This is further supported by data shown in Figure 15. The total growth factor was based, therefore, on projected increases in both population and vehicle ownership and amounted to an 88 percent increase in travel between 1961 and 1981, as follows:

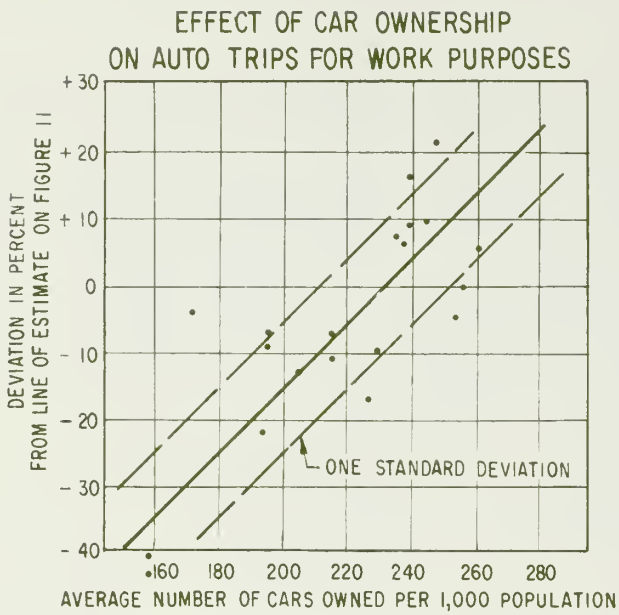
	1961	(Estimated) 1981	Percent Increase
(A) Population	61,414	102,000	66
(B) Vehicles Owned per Thousand Population	420	475	13
(A) x (B) = Total Vehicles	25,794	48,450	88

FIGURE 13



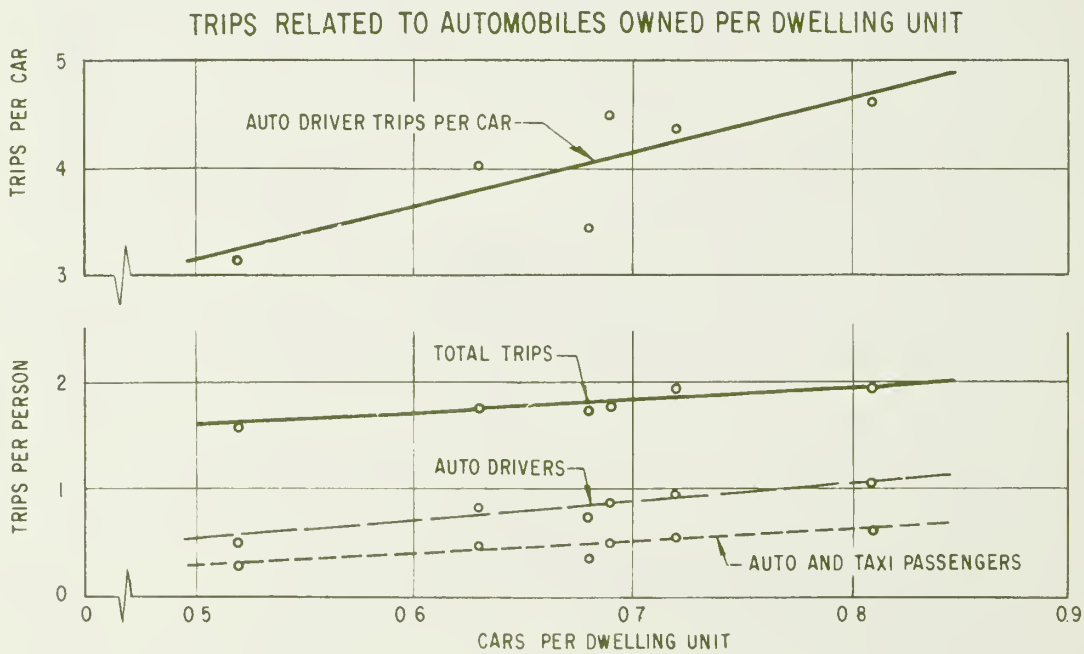
TRENDS IN YELLOWSTONE COUNTY POPULATION, VEHICLE REGISTRATIONS AND PERSONS PER VEHICLE

FIGURE 14



Source: Highway Research Board Bulletin 119, pg. 56

FIGURE 15



Source: Highway Research Board Bulletin 203, pg 127

Conferences were held with local officials, civic leaders and long-time residents of Billings in order to arrive at growth factors for trips to types of land use other than residential. These growth factors were based, therefore, on the best intuitive judgment of a group of local residents most familiar with current trends and future needs. Table 12 summarizes all growth factors used in expansion of the traffic data.

Special procedures were required in forecasting future trips to a small number of zones which generated no trips in 1961 or to which the number of trips in 1961 was small enough to produce an exceptionally large expansion factor. In these instances, additional trips were simulated on the basis of travel characteristics of adjoining or nearby zones. Expansion factors greater than 10.0 were reduced through trip simulation in order to assure that no single trip was given undue weight in the expansion.

Zonal expansion factors and the estimated number of trip ends in each zone in 1981 are shown in Table 12. The table shows actual expanded volume of trip ends for internal zones in 1981 to be 88 percent larger than the 1961 total. Projections were also made of population growth and increased vehicle registration in each zone of Yellowstone County outside of the internal survey area. Expansion factors for trips crossing the external cordon line to or from zones within Yellowstone County but outside of the internal survey area were expanded on the basis of these projections. External trips with origins or destinations outside of Yellowstone County were expanded in accordance with forecasts of future travel in the United States.[1] Trips through external stations, it has been estimated, will increase by 186 percent by 1981. The average expansion factor for all trips, weighted by the number of trip ends, amounts to an increase of 97 percent over 1961. Through use of the factors shown in Table 12, estimated zone-to-zone traffic movements in 1981 were determined by successive approximations. The expansion was made in four approximations on an IBM 7090 electronic computer.

[1]"Forecasts of Population, Motor Vehicle Registrations, Travel and Fuel Consumption", Public Roads, Vol. 30, No. 12, Bureau of Public Roads, U. S. Department of Commerce, February 1960, p. 269.

ESTIMATED TRAVEL IN 1981

Estimated 1981 zone-to-zone trips are shown in Tables C-1, C-2, D-1 and E-1 (1981) in the back pocket of this report. Table C-1 (1981) summarizes total person trips within the internal survey area in 1981. Table C-2 (1981) shows zone-to-zone auto trips for both internal and external travel. Truck trips are summarized in Table D-1 (1981) and Table E-1 (1981) shows the total number of vehicular trips.

Tables in the back pocket of the report have been prepared in "rectangular"fashion. All trips are shown "from" one zone or station "to" another and represent, therefore, one-way travel. To determine the total trips "between" any two zones, the trips for each direction of travel must be added together.

The following table summarizes estimated 1981 travel in the Billings metropolitan area.

	Internal Trips		Trips Between Internal Zones and External Stations		Through Trips		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Autos (Including Taxis)	235,661	84.5	55,320	75.8	7,159	69.2	298,140	82.3
Trucks	43,157	15.5	17,679	24.2	3,184	30.8	64,020	17.7
Total Vehicle Trips	278,818	100.0	72,999	100.0	10,343	100.0	362,160	100.0
Person Trips	405,945							

ESTIMATED 1981 TRAVEL DESIRES

Desire line charts, similar to those shown previously for present travel, were prepared to portray 1981 travel desires. These provide a visual comparison of present and predicted traffic when viewed in conjunction with Figures 3, 4, 5 and 6.

Travel To and From the C.B.D.

Figure 16 shows estimated 1981 trip desires to and from the central business district. The estimated total of 71,025 trips in 1981, which excludes those trips with both origin and destination in the C.B.D., represents an increase of 56.7 percent over those in 1961. See Figure 3. Some of the largest increases in travel desires will occur between the central business district and the Billings Bench area, the airport,and areas west of the central business district.

Travel Between Internal Districts

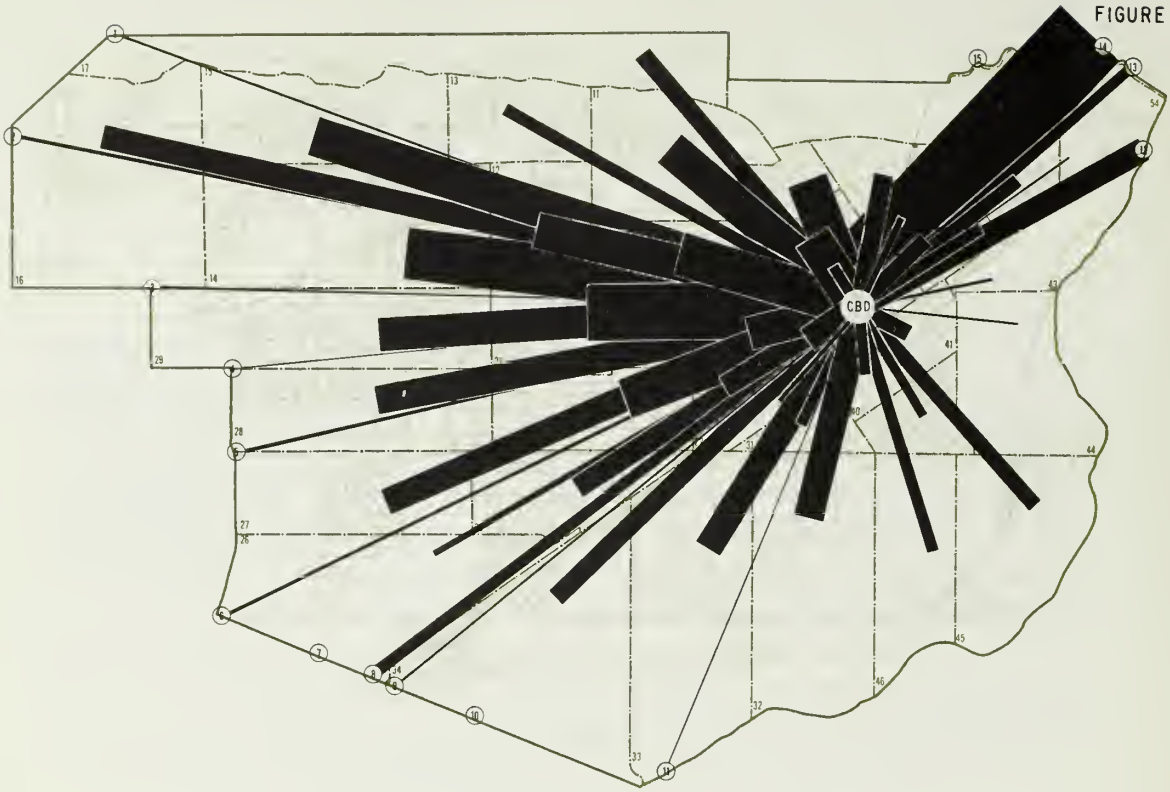
Figure 17 shows 1981 travel desires between all internal districts except the central business district. It has been estimated that 212,921 vehicle trips will have origins and destinations within the internal survey area but outside of the central business district. This is 94.5 percent greater than the number indicated in the 1961 survey.

The dramatic confluence of 1981 travel desires in the northwest section of the internal survey area is evident in Figure 17. The area in the vicinity of Broadwater and Grand Avenues and Poly Drive between Eighth and 24th Streets West is shown as almost a solid mass of trip desires at the selected scale.

Travel Between Internal Districts and External Stations

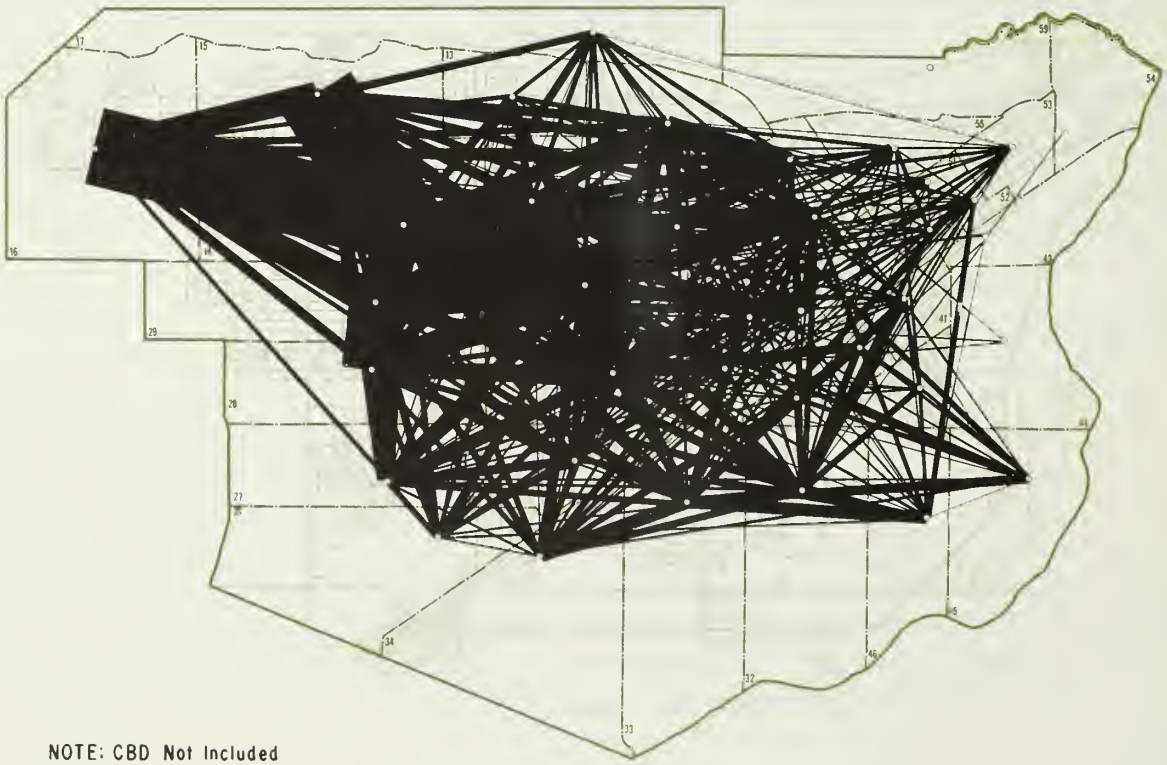
Travel desires between internal districts and external stations in 1981 are shown in Figure 18. There will be an estimated 72,999 trips in this category in 1981 compared with 26,539 trips in 1961, or an increase of 175.1 percent in the 20-year period. Interstate Highway 90 on the west and U.S. Highways 10 and 87 on the east continue to show the largest number of trip desires. Significant increases are also forecast at external stations 2 through 6 on the west side of the internal survey area.

FIGURE 16



DESIRE LINES OF TRAVEL TO AND FROM C.B.D.-1981

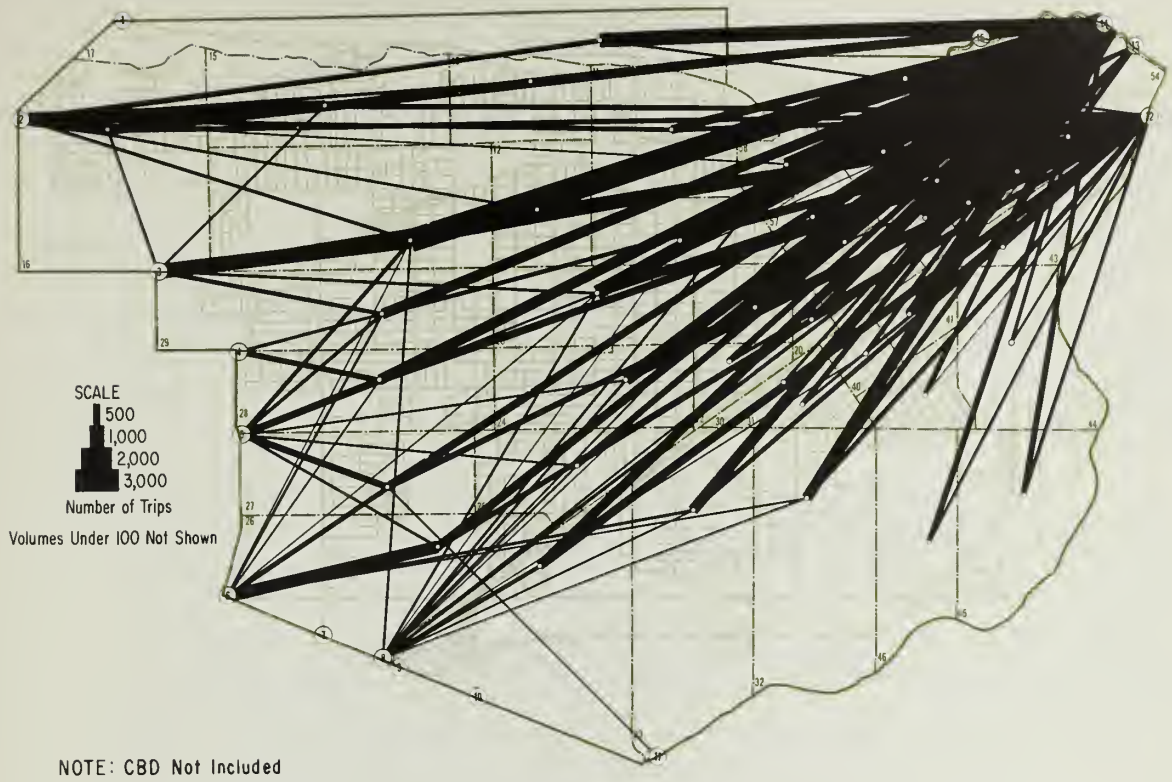
FIGURE 17



NOTE: CBD Not Included

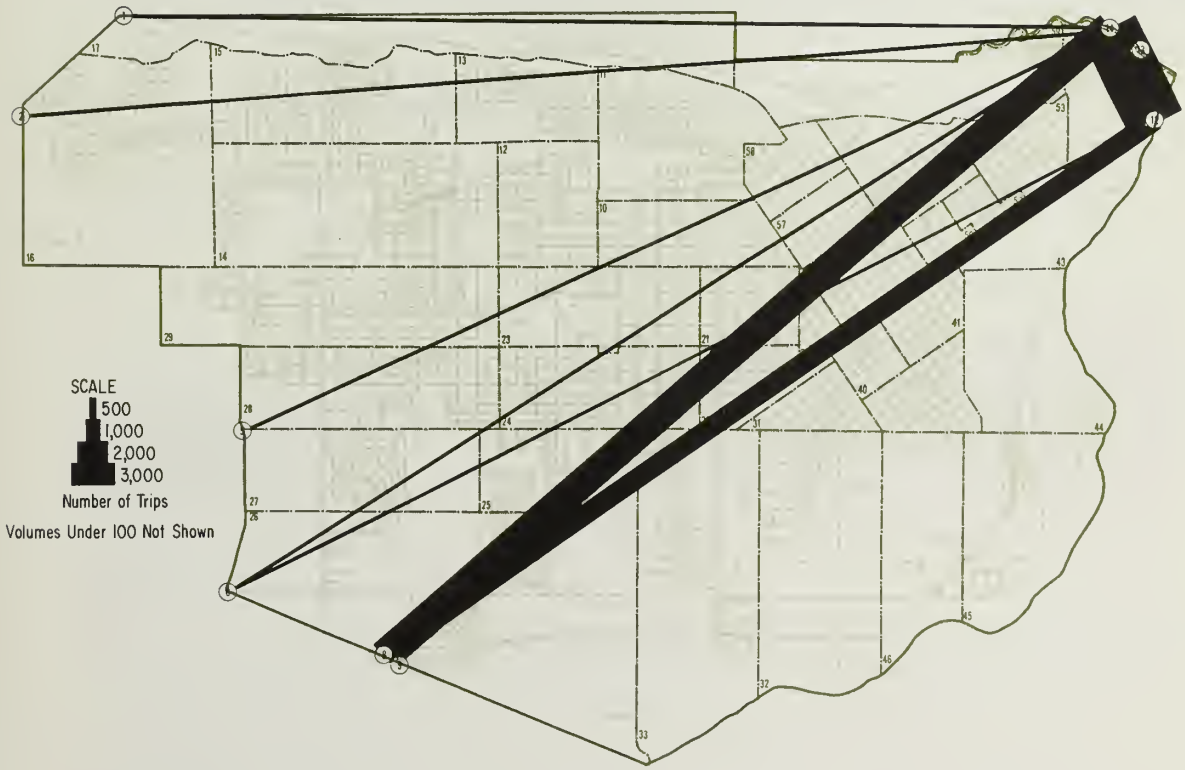
DESIRE LINES OF TRAVEL BETWEEN INTERNAL DISTRICTS - 1981

FIGURE 18



DESIRE LINES OF TRAVEL BETWEEN EXTERNAL STATIONS AND INTERNAL DISTRICTS – 1981

FIGURE 19



DESIRE LINES OF TRAVEL BETWEEN EXTERNAL STATIONS – 1981

Through Travel

It is estimated that the number of through trips (those without a significant stop in the internal survey area) will increase from 3,138 in 1961 to 10,343 in 1981, or by 229.6 percent. Desire lines of through travel are shown in Figure 19.

The general pattern of desires for through travel is not expected to change materially from that shown in Figure 6. Primary desires of drivers passing through the area will continue to be between Interstate Highway 90 on the west and U.S. Highways 10 and 87 on the east. A large band of desires is also indicated on U.S. 87 at the northeast corner of the internal survey area.

Chapter VII

TRAFFIC ANALYSIS

EVALUATION OF THE PRESENT SYSTEM FOR EXISTING TRAFFIC

A good arterial street system should provide a direct, safe and free-flowing route for a large portion of the trips made within the area. A poor system requires many motorists to take indirect routes and has numerous bottlenecks where traffic flow exceeds the capacity of the intersections.

Figures 3, 4, 5 and 6 on pages 29 and 31 show the desire lines of flow for motorists now using the existing arterial street system. The heavy flow bands fall in one or more of the following groupings:

1. Radial to the central business district;

2. Parallel to Grand and Broadwater Avenues; or

3. Generally parallel to the Northern Pacific tracks.

All of the above desire lines of travel are served by reasonably direct routes. With the possible exception of a lack of continuity of through north-south streets on the west side, the system is complete enough to let most motorists take direct routes between their origins and destinations.

Capacity Analyses

Capacity is defined as the ability of a roadway to accommodate traffic.[1] When compared with present or anticipated volumes, it provides an indication of the sufficiency of a facility.

[1]"Highway Capacity Manual", U.S. Department of Commerce, Bureau of Public Roads, 1950, p. 5.

Capacity is defined in three ways by the Bureau of Public Roads in the "Highway Capacity Manual":

1. Basic Capacity - The maximum number of passenger cars that can pass a given point on a lane or roadway during one hour under the most nearly ideal roadway and traffic conditions which can possibly be obtained.

2. Possible Capacity - The maximum number of vehicles that can pass a given point on a lane or roadway during one hour under the prevailing roadway and traffic conditions.

3. Practical (or Design) Capacity - The maximum number of vehicles that can pass a given point on a roadway or in a designated lane during one hour without the traffic density being so great as to cause unreasonable delay, hazard or restriction to the drivers' freedom to maneuver under the prevailing roadway and traffic conditions.

These definitions are stressed and repeated at this point to clarify the conditions under which sufficiency of the street system has been analyzed. Improvements should be planned to accommodate anticipated traffic adequately at practical (or design) capacity. The underlying concept is to provide facilities which will operate satisfactorily without causing unreasonable delay or restriction to the drivers' freedom to maneuver. Unless specifically excepted, the use of the term capacity throughout the remainder of the report will refer to practical or design capacity.

The capacity of urban arterials, except those with limited access, is governed by the volumes of traffic which can be handled at principal intersections. Under ideal operating conditions, one lane of roadway might handle more than 2,000 vehicles per hour. Interruptions in flow caused by conflicting traffic movements at at-grade intersections, however, drastically reduce the ability of a facility to accommodate traffic.

Factors which enter into the analysis of the capacity of an intersection include:

1. The width of both the main and cross streets;

2. The volume and distribution (i.e. through, left-turning or right-turning) of traffic on the cross street;

3. The proportion of vehicles turning right or left from the main street;

4. The type of area in which the intersection is located--downtown, intermediate or rural;

5. The proportion of trucks and buses on the main and cross streets;

6. Parking conditions and bus stops;

7. The type of operation--one-way or two-way; and

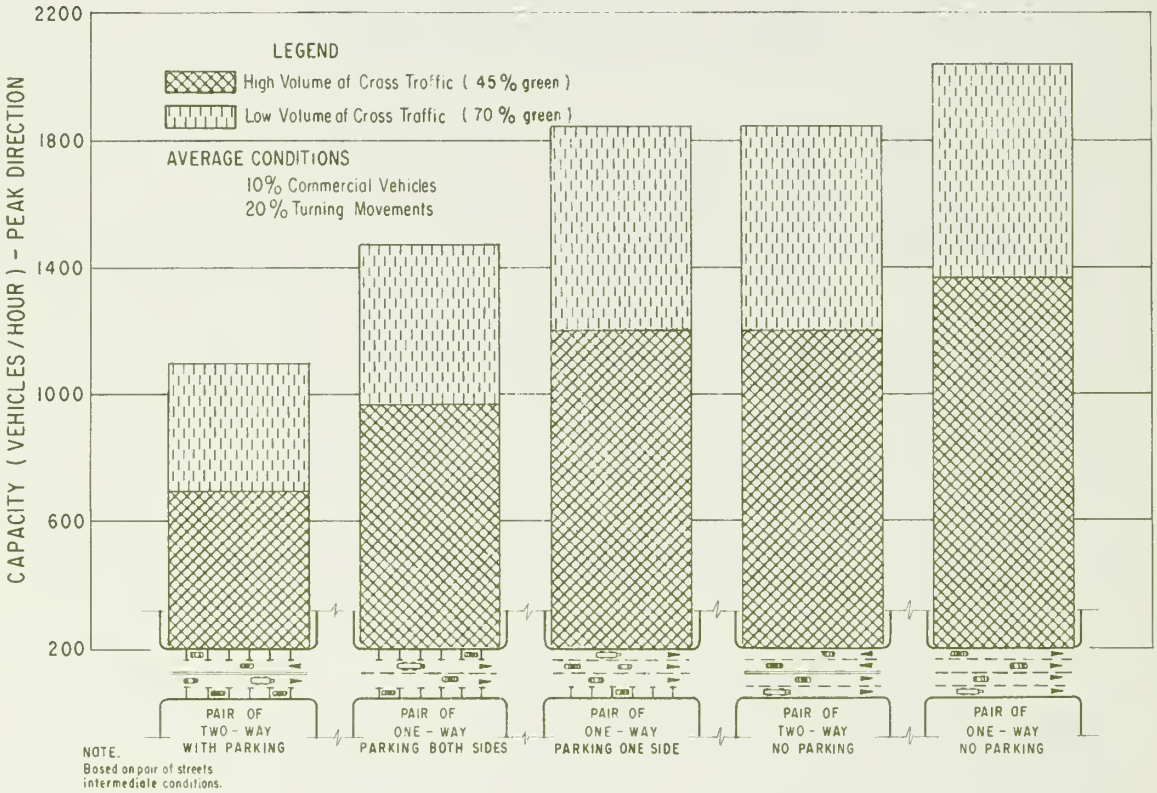
8. Pedestrian interference, when applicable.

Figure 20 shows the design capacity of a 48-foot street under various conditions. A one-way street with parking on both sides has approximately 38.6 percent more capacity than a two-way street with parking on both sides. A pair of one-way streets with parking on one side has essentially the same capacity as a pair of two-way streets without parking, while also providing an extra parking lane on each street. When an existing two-way street with parking on both sides becomes overloaded, the capacity can be increased by removing parking from one or both sides and/or by converting to one-way operation.

Each major intersection on the urban arterial street system was analyzed to determine its capacity under prevailing roadway and traffic conditions. The analyses were made by assuming that each intersection was signalized and assigning available green time to each traffic movement on the basis of the proportional distribution

of present traffic. The analyses were made graphically through use of "Design Capacity Charts for Signalized Street and Highway Intersections" by J. E. Leisch.[1]

FIGURE 20



DESIGN CAPACITY OF 48 FOOT STREET - AVERAGE CONDITIONS

Exhibit 13 shows the sufficiency rating, or percentage of volume to capacity at 58 major intersections in the Billings urban area. Of these, 43 were found to have adequate capacity under existing conditions for present peak-hour traffic movements. Of the 15 intersections where present traffic exceeded capacity, most were in or near the central business district.

[1] "Design Capacity Charts for Signalized Street and Highway Intersection", by J. E. Leisch, Public Roads Magazine, Volume 26, No. 6, 1951. pp. 105-139.

Possible capacity is from 20 to 60 percent greater than practical capacity, depending on street width, location and parking conditions. It is our conclusion that there were no intersections in the Billings urban area in 1961 where traffic volumes exceeded possible capacity. Traffic flow at a number of the major intersections, however, exceeded practical capacity, indicating that intersection improvements or additional routes were required. Most intersections showing deficiencies in capacity were in older sections of the city. In sections of the area which are developing most rapidly at the present time, the opportunity exists to improve critical intersections before deficiencies occur.

The analysis shows that Billings has a good arterial street system for existing traffic. The streets provide the majority of motorists with direct routes of travel with only a few locations where congestion causes undue delays.

Improvements should be made immediately at such locations. Future needs should also be considered, however, since the number of registered passenger vehicles in Yellowstone County are expected to double within the next 20 years. This increase will be caused both by expected population growth and by higher rates of vehicle ownership per capita. The average length of trip will be greater, furthermore, since the city will be larger. It is necessary, therefore, to estimate future traffic volumes.

1961 TRAFFIC ASSIGNMENTS

In order to predict traffic flow on the arterial street system at the 1981 traffic level, it was first necessary to perfect the techniques for making projections by testing tentative formulae against the existing street network and known traffic volumes.

First 1961 Traffic Assignment

A motorist considers both time and distance when he selects his route of travel. A computer program was modified so

as to assign traffic to the "cheapest" route when time was valued at two cents per minute and distance at four cents per mile. The existing arterial network was coded in computer language by assigning numbers to each intersection together with time and distance values for each link between intersections. This information was fed into the computer, and the best route from each zone center and station to each other such point was determined. Since there were a total of 151 zones and stations, approximately 115,000 combinations were determined. A printout of six sample trees [1] was checked to see that routes selected by the computer were logical. Minor errors were corrected. Finally, 1961 origin-destination information was assigned to the network as indicated by the routings determined by the tree building.

A printout of this assignment showed the estimated traffic on each link by direction and the estimated turns at each intersection. With few exceptions, the assigned traffic compared quite favorably with actual ground counts. It was decided to modify the travel times on certain of the major streets and make a second 1961 assignment.

Second 1961 Traffic Assignment

For this assignment, estimated travel speeds on Lewis Avenue were reduced so as to permit the traffic assignments to Grand Avenue and Lewis Avenue to be more realistic. This and several other minor modifications were made in the network description and the second 1961 traffic assignment was made. The results of this assignment were also compared with the ground counts and are shown in Table 13. There is close correlation of counts and assigned traffic when half-mile corridors are considered.

[1] A tree is the aggregate of all routings from a zone centroid to all other zone centroids.

1981 TRAFFIC ASSIGNMENTS AND CAPACITY ANALYSIS

1981 Traffic Assignment to the Committed Street System

The committed street system studied included all existing arterial streets plus certain planned improvements. The planned improvements are as follows:

1. Interstate Route 90 passing south and east of Billings with a west interchange near Edward and King Streets, a south interchange on 27th Street South and a Lockwood interchange east of the Yellowstone River;

2. The new and improved Sixth Street West underpass of the Northern Pacific Railway; and

3. Fifteenth Street West extended as a primary arterial from Central Avenue to Poly Drive.

Exhibit 14 shows estimated 1981 average daily traffic volumes on the presently committed street system. Traffic volumes in excess of 20,000 vehicles per day would occur on sections of Poly Drive, Grand Avenue, Broadwater Avenue, Central Avenue, Montana Avenue, First Avenue South, First Avenue North, Second Avenue North and 27th Street North. Grand Avenue presently has certain sections that carry 12,000 vehicles per day.

The 27th Street interchange would serve Interstate highway motorists having an origin or a destination south of the Northern Pacific Railway tracks. This interchange would serve few motorists having origins or destinations north of the tracks, since the use of this interchange would entail longer trips in both time and distance.

Committed System Intersection Capacity Versus 1981 Volumes

Exhibit 15 shows the comparison of estimated 1981 average daily traffic volumes with existing capacity of major intersections on

the committed system. Of the 71 intersections shown, traffic volumes would exceed practical capacity at 49. Volumes at 23 of these would be over 150 percent of capacity. Various improvements will be needed to increase the capacity of the existing street system for future traffic volumes.

1981 Traffic Assignment to Tentative System

Traffic was assigned to a tentative arterial street system. The tentative system included all of the features of the committed system plus the following improvements:

1. The extension of certain streets to provide continuity and serve developing areas;

2. The establishment of one-way streets to reduce conflicts, increase capacities, provide greater safety and, in general, make driving easier for the traveling public; and

3. The construction of an additional Interstate highway interchange near the Fairgrounds to provide a congestion-free route of travel for a large number of motorists, to allow greater use of the Interstate, and to reduce traffic volumes near the central business district and on U.S. Route 87-212 Yellowstone River bridge.

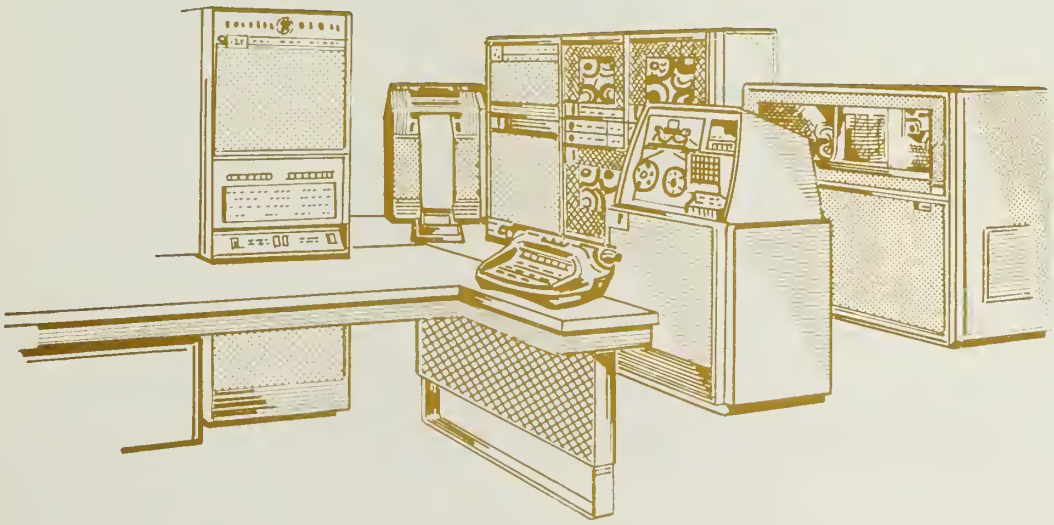
A printout of the computer assignment to this tentative system gave estimated traffic on each link by direction as well as the estimated number of vehicles turning at each intersection.

Analysis of the results of the assignment together with capacity studies showed that most of the improvements of the tentative system would do much to reduce congestion and improve service; but modifications to some improvements and additional improvements would be required to adequately handle anticipated 1981 traffic.

1981 Traffic Assignment to Recommended System

The recommended system contains most of the tentative system plus additional street extensions, additional one-way streets, and modifications to the proposed East Interchange near the Fairgrounds.

The fifth and final traffic assignment provided estimated 1981 average daily traffic on the recommended system. Details of the recommended system and its capacity analysis will be discussed in the following chapter.



Chapter VIII

RECOMMENDED ARTERIAL STREET SYSTEM

GENERAL ASPECTS

Capacity analysis of the existing and committed arterial street systems indicated the locations where improvements should be made in order to handle estimated 1981 traffic. The recommended system has been tailored to provide direct, fast and safe routes of travel for motorists in the future. Since 1981 traffic is expected to be 1.97 times 1961 traffic volumes, the present system will require street extensions, widenings, channelization, one-way streets, new interchanges, new railroad grade separations, parking restrictions and progressive signal timing. Table 14 shows a comparison of estimated 1981 24-hour traffic volumes with 1961 24-hour traffic counts along the major arterial streets.

Use of a pair of one-way streets to solve an isolated traffic problem and use of a number of one-way pairs in an overall system frequently has been found effective. The reasons are many:

1. Total traffic of two two-way parallel streets, one over-loaded and the other lightly used, can sometimes be divided equally between the two streets by instigating one-way movement on them as a complementary pair.

2. Under certain conditions, it is possible to use one-way pairs and have at least one parking lane on each street which could not remain were the streets to operate as two-way arteries. This is an especially important advantage in downtown or other commercial areas.

3. The greater ease of movement due to lessened congestion and simpler maneuvering off-sets indirect

routing and other inconveniences of one-way streets. This holds potential shoppers in downtown or other commercial districts who might otherwise be diverted to competing facilities. One city, after installing a one-way pair found business up two percent the first year after installation, while retail business in the remainder of the county dropped 1.3 percent.[1]

4. Using the one-way street solution to a capacity problem generally costs less than an alternative two-way system. This is so because the use of one-way streets usually eliminates most of the channelization and street widening otherwise necessary; it also simplifies traffic signal phasing, permitting use of less complicated and less expensive signal equipment. Sacramento installed a successful one-way pair of streets at a cost of $23,000, while a two-way system of equivalent capacity would have cost $1,300,000.

5. Past experience of other cities in the use of one-way streets has been similarly favorable.[1,2]

   a. Delays have been cut over 30 percent.
   b. Average speeds have increased greatly without necessarily higher crest speeds.
   c. Greater volumes of traffic have been served.

[1]Faustman, D.J., "Appraisal of One-Way Street System in Sacramento, California", ASCE Proceedings Separate 234, August 1953, 6 pp.

[2]City of Sacramento, "Improving Traffic Access in Central Business Districts", February, 1950.

Maier, E., "Traffic Improvements Through Restrictive Traffic Controls", Proceedings I.T.E., 1948, pp. 123-134.

National Research Council, Highway Research Board, "One-Way Streets", Bulletin 32, December, 1950, 33 pp.

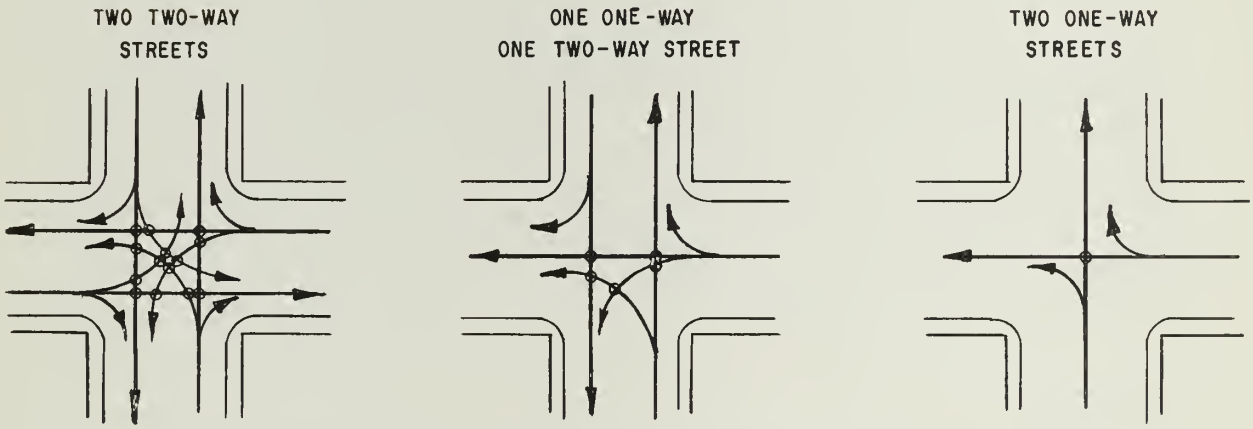
Matson, T., et al., Traffic Engineering, McGraw-Hill, 1955, pp. 260-277.

Smith, W.S., and Hart, J., "A Case Study of One-Way Streets", Traffic Quarterly, October, 1949, pp. 378-399.

Fowler, F.T., "One-Way Grid System of Portland, Oregon," Proceedings I.T.E., 1952, pp. 56-59.

6. Increased safety arising from the correct installation of one-way streets is of great importance in a metropolitan area such as Billings. "One-way streets have a number of characteristics which should enhance highway safety. First, there are few points of potential conflict at intersections (as shown in Figure 21).

FIGURE 21



BASIC CONFLICTS IN TRAFFIC MOVEMENTS

Second, with no opposing traffic, the chance of head-on and side-swipe accidents is virtually eliminated. Third, turning vehicles can be passed, thereby reducing the possibility of rear-end collisions. Fourth, and perhaps most important, signals can be timed for progressive movement, reducing the number of stops and keeping vehicles in orderly groups, with well-defined intervals between groups for pedestrian and vehicle crossings. These are some of the more important benefits demonstrated by experience."[1]

[1]Schoppert, D.W., Traffic Control and Roadway Elements, Automotive Safety Foundation, 1963, pg. 74.

As an example, a study[1] of 12 cities showed that after installation of a one-way couplet, the overall accident rate fell 26.8 percent while vehicle-miles of travel rose 23.4 percent. "It was found, too, that rear-end, turning and pedestrian accident rates at and between intersections decreased, as did those for side-swipe, parking and backing between intersections. Rates for other types of accidents remained substantially unchanged."[2]

The recommended system has evolved during many months of study. The recommendations have been discussed in detail with Federal, State and City officials as well as with local merchants and residents. It is believed that the recommended system will provide maximum service at minimum cost. More grandiose systems could have been devised. An elaborate expressway network would provide slightly better service, for example, but would be much more costly and require heavy right of way takings.

The System

Exhibit 16 shows the recommended arterial highway system for the Billings internal area plus certain extensions outside of the area to the west. All of the major improvements and almost all of the primary arterials will be discussed in detail later in this chapter.

Assignment Information

Before assigning traffic to the recommended arterials, it was necessary to estimate average driving speeds for each segment of the system. Except where improvements would allow reduction in travel time, speeds were estimated to be the same in 1981 as in 1961. The estimated speeds for the recommended system are shown in Exhibit 17. Exhibit 18 shows the traffic assignment network for the recommended system. The estimated average daily traffic volumes on the recommended street system are shown in Exhibit 19.

[1]Oregon Highway Commission, Technical Report No. 59-4, 1959, 100 pp.

[2]Schoppert, D.W., Traffic Control and Roadway Elements, Automotive Safety Foundation, 1963, pg. 74.

Typical Sections

Since the capacity of arterial and other streets varies with the width of pavement, it is necessary to have a specific cross section in mind when testing the system. In designing the cross section of an arterial, the needs for traffic lanes, parking lanes, medians, borders, and other elements must be weighed against one another and a balance sought in the full cross section. The summation of the widths of all necessary elements determines the right of way width desirable. On the other hand, right of way limitations govern the manner in which the cross section elements can be combined. Typical cross sections are shown in Exhibit 20. In 1954, the City Council of Billings passed an Ordinance stating that sections of the following streets should have 48-foot pavements: Rimrock Road, Poly Drive, Grand Avenue, Broadwater Avenue, Central Avenue, Lewis Avenue, and Parkhill Drive. These streets, for the most part, have 60-foot right of way at present. A 48-foot pavement would leave a six-foot margin on each side of the street. This would allow little room for sidewalks and thereby limit pedestrian capacity.

Generally, these designated street widths have been adopted in the recommended plan. Where capacity requirements are such that the existing width will be sufficient, although below the designated minimum, however, widening has not been indicated on the recommended plan. For most other arterials with a 60-foot right of way, a pavement width of 44 feet has been recommended. In the second section of the Ordinance, certain streets--most of which are now in the arterial system--were designated to have a minimum pavement width of 40 feet. It is suggested, however, that the minimum width be raised to 44 feet so that four 11-foot lanes can be used to move traffic should intersection volumes require it. Should one-way streets be used, the minimum width could be reduced to 36 feet. The third section of the Ordinance sets minimum pavement widths for various right of way. The 50- and 60-foot right of way apply to arterial streets as dealt with in this report. We are in general agreement with the widths set in these cases.

INTERSTATE ROUTE 90

Interstate Route 90 is planned to be a major east-west highway from Boston, Massachusetts, to Seattle, Washington. As it passes through Yellowstone County, Interstate 90 is proposed to bypass Billings south of the present city limits. Interstate 90 will cross the Yellowstone River from the east approximately 1,000 feet south of the existing bridge on U.S. 87-212, then bypass Billings on an alignment parallel to and approximately 1,500 feet south of King Avenue, and connecting with existing Interstate 90 west of Billings. Three interchanges are proposed to serve the metropolitan area. The general alignment in shown in Exhibit 16.

West Interchange Area

As the study progressed, it became apparent that there were no suitable north-south streets between 12th Street West and 24th Street West, to handle the projected volumes and to provide the needed access to Interstate 90. The proposed west interchange showed a connection to King Avenue, but no means to go directly north from there. Investigations in the field showed that it would be possible to extend 19th Street West south from Central Avenue to King Avenue and thereby provide an improved connection to the Interstate from the west side of the city. The proposed extension of 19th Street West is discussed in further detail in the section dealing with that facility. Recommended improvements in the west interchange area can be seen in Exhibit 21.

Recommended East Interchange to the Interstate

As our analysis progressed, it became apparent that the Interstate highway would not carry as much traffic as might be expected. Much of the bypassable traffic, moreover, would be required to pass through or near the central business district unless an additional point of access to the Interstate were provided. Several locations were investigated, and the area south of the Northern Pacific Railway tracks between the Yellowstone River and a hypothetical extension of South 13th Street appeared to be the most

logical point for another interchange. It was reasoned that traffic approaching Billings from the east could be diverted from the already overloaded U.S. 87-212 Yellowstone River bridge to the new Interstate bridge which will have excess capacity. Traffic could then enter Billings either via the 13th Street underpass or via Minnesota Avenue and First Avenue South. It was realized that the capacity of the existing two-lane underpass at 13th Street would not be adequate to handle large volumes of traffic, and that it would be necessary to provide an additional underpass in the area to divert some of the traffic from the 13th Street underpass. Several locations were studied, and the most feasible one was deemed to be at 15th Street. It was decided, therefore, to investigate the possibility of a one-way street couplet between Minnesota Avenue and Sixth Avenue North, utilizing North 13th Street for northbound traffic and North 15th Street for the reverse flow. This would permit traffic using the new east interchange to distribute itself over several major east-west streets. See Exhibit 22.

The large volumes of traffic originating southwest of town and destined for the Billings Bench area and beyond would be able to bypass the central business district by using the new east interchange, North 13th Street, and either Fourth Avenue North or Sixth Avenue North, rather than following the long route through town using many streets including First Avenue South.

It was found that the east interchange would permit the Interstate between the east and Lockwood interchanges to provide 1.61 times as much traffic service in 1981--from a weighted average of 5,840 vehicles per day to an estimated 9,410 daily vehicles. The existing U.S. Route 87-212 Yellowstone River bridge traffic would be reduced to 7,400 vehicles per day, which is only three percent greater than the present volume. Should the east interchange not be constructed, the Yellowstone River bridge would be forced to carry approximately 20,000 vehicles per day. This would necessitate the reconstruction of the old Yellowstone River bridge as well as the railroad overpass of U.S. Route 87-212 over the Northern Pacific Railway tracks east of the Yellowstone River. Inclusion of this interchange would also reduce greatly the amount of traffic at the U.S. 87-212, U.S. 10-312 intersection at the entrance to the Fairgrounds, as well as reduce the amount of traffic passing through and near the central business district.

CRITICAL LOCATIONS

The geometry of the street system in Billings, when combined with traffic patterns, results in critical conditions at certain points and in some whole areas. The recommended improvements to enable the street and highway system to serve estimated 1981 traffic are shown in Exhibits 21 to 26, 28 and 29. The critical areas include the east and west interchange areas of Interstate 90, discussed above; Division and North 32nd Streets; the central business district; Poly Drive and Grandview Boulevard; Central Avenue and Montana Avenue; U.S. Routes 10, 87 and 212; and North 13th and 15th Streets.

Division - North 32nd Streets

Division Street, as its name implies, divides the old street pattern parallel and perpendicular to the railway tracks from the new pattern which has north-south and east-west orientation. Therefore, the street has several intersections of five or more points of entry, and almost all cross streets are off-set at Division. While North 32nd Street serves much the same type of traffic, Division Street operates at a much more congested level.

In order to improve overall capacity, lessen delays and reduce accidents, it was decided to investigate the possibility of making Division Street one-way southbound and North 32nd Street one-way northbound. This would permit more efficient use of the two streets. Elimination of certain of the conflicting traffic movements along Division Street would make it possible to channelize the remaining movements in an orderly manner. The resulting plan is shown in Exhibit 23.

Results of the study showed that:

1. Division Street could continue to operate without any pavement widening while continuing to permit parking, much as at present.

2. Confusing traffic movements could be prohibited and intersections simplifed at North 33rd, 34th

and 35th Streets along Division. Also, parking space could be provided at North 33rd and 34th Streets in the short sections proposed to be closed off.

3. The present width of North 32nd Street would be adequate, even with continuation of curb parking along most of its length.

4. The intersection of Grand Avenue, Sixth Avenue North, Division Street and North 32nd Street has been designed with appropriate channelization to operate on a three phase traffic signal. Estimated 1981 traffic volumes would be only slightly above design capacity. A great portion of the cycle would be required by the phase allowing vehicles from Grand Avenue to continue toward the central business district.

Central Business District

Investigation of the overall intersection capacity in the downtown area showed that the recommended system would operate satisfactorily with 1981 volumes. Inclusion of the one-way pairs of North 27th and 28th Streets and Montana Avenue and First Avenue North would make it possible for traffic to flow within design capacity levels without any widening or taking of right of way in the central business district. Furthermore, only peak-hour parking restrictions would be required to accommodate the anticipated traffic volumes.

Treatment of intersections in the central business district would be greatly simplified because of the proposed one-way movements at critical volume locations. Little channelization would be required. One exception would be the intersection of Montana Avenue and North 28th Street where three southbound lanes should be provided. The fourth lane could be used for direct access to the Downtown Merchants' Garage to avoid the detour otherwise required for vehicles approaching the garage from the west. The balance of the lane north

of the alley between Montana Avenue and First Avenue North could be used as a loading zone to serve the Northern Hotel.

The treatment of the central business district is shown in Exhibit 24. Quick and easy access to shops and offices in downtown Billings assured by the plan should enable the area to continue to be a strong magnet for commercial and business traffic, as well as for work trips.

Poly Drive - Grandview Boulevard

Capacity analyses were made of the intersections along Grandview Boulevard and Poly Drive between North 28th Street and Fifth Street West. These showed that excessive widenings and taking of property would be required to provide for two-way traffic on Poly Drive. This would include covering of the B.B.W.A. Canal across Virginia Lane. Furthermore, an elaborate three phase traffic control system would be required to handle the movements. It was decided, therefore, to recommend that these two facilities be combined as a one-way couplet in the section mentioned.

This section of Poly Drive and Grandview Boulevard provides an important point of distribution of traffic to and from the downtown area and the northwest Billings metropolitan area. Traffic also transitions from one grid orientation to the other in this section. The use of Grandview Boulevard and Poly Drive as a pair of one-way streets would provide transition opportunities (to be discussed below) as well as the high level of operation that this area requires. Analysis of the one-way pair resulted in the recommendations shown in Exhibit 25.

Beginning at the west end of the couplet, the intersection of Poly Drive, Fifth Street West, Virginia Lane and Grandview Boulevard will require widening and channelization for the transition to and from one-way flow. The Grandview Boulevard connection across Fifth Street West to Poly Drive will require widening to 40 feet within the present right of way. Grandview Boulevard, to carry out the recommended plan, will have to be widened within the right of way to 36 feet from the Poly Drive connection to Locust Street. It would be realigned at this point, cutting across a short piece of new right of

way to form the connection with Elevation Avenue, which will also have to be realigned. Elevation Avenue will continue along new alignment to its intersection with North 28th Street and Poly Drive, where two-way flow will be resumed. This realignment of Elevation Avenue will require closing the present street to traffic, permitting conversion of vacated land to other uses. Poly Drive will have to be widened to 36 feet from the intersection with Fifth Street West to Normal Avenue. The intersections of Poly Drive and North 28th Street and Poly Drive and North 27th Street have been highly channelized in the plan mainly because of the connections with the 27th Street and 28th Street one-way pairs in that area. The location of required widening can be found in Exhibit 26, while new right of way is shown in Exhibit 27. The general treatment described above would allow a simpler and better movement of traffic in the area than any other scheme studied.

Central Avenue - Montana Avenue

The Central Avenue-Montana Avenue-Fifth Street West-Sixth Street West area is another zone of potential congestion which required special consideration. One major feature is the recommended left-hand couplet of one-way streets along Fifth Street West and Sixth Street West. As shown in Exhibit 28, this will eliminate a problem otherwise arising from movements to and from the nearby interchange. Traffic proceeding south on Fifth Street West and destined for an area south and west of Billings would turn right at Montana Avenue, use the railroad overpass, and continue to the Interstate highway. The reverse movement would be made by leaving the main roadway before the overpass and using the underpass to continue directly north on Sixth Street West. A more detailed description of the one-way pair follows in a later section.

Normally, there is a conflict at the terminals of a left-handed couplet of one-way streets since it is necessary for the two movements to crisscross at the ends. There would be no conflict at this location, however, since one movement would use the overpass and the other the underpass.

A short section of one-way street will be required on St. Johns Avenue between Sixth Street West and the intersection with

Montana Avenue to act as a companion for the one-way westbound section on Central Avenue between Fifth and Sixth Streets West. However, it is recommended that the remaining segment of St. Johns Avenue operate one-way eastbound to serve as an optional point of access to Montana Avenue for use either as a staging procedure or as an alternative to the proposed ramp.

The recommended widenings in this area are shown on Exhibit 28.

U.S. Routes 10, 87 and 312

The estimated large volumes of traffic by 1981 between external areas to the northeast and the internal districts of Billings now served mainly by U.S. Routes 10, 87 and 312, indicate the need for upgrading the highway and those major urban arteries connecting these consolidated routes with the downtown area.

The recommended improvements for the area are shown on Exhibit 29. The intersection with Sixth Avenue North will require some channelization, particularly to handle the movement to and from the U.S. highway to the north and Sixth Avenue North. Sixth Avenue North will require widening to provide four moving lanes; this improvement should extend west to North 15th Street. At the intersection with Fourth Avenue North, an entrance has been proposed to the north parking area of the Fairgrounds. This intersection would be channelized to improve operation. Third Avenue North, a relatively unused facility in this area at the present, should be improved through widening to provide two moving lanes in each direction between intersections and added lanes at intersections as required. It is recommended, therefore, that Third Avenue North be made four lanes wide. This will involve widening from the U.S. highway westerly to North 11th Street. The intersection with First Avenue North, because of the geometry and distribution of movements, will require extensive channelization. It has been recommended, therefore, that the design be such that the entrance to the Fairgrounds at this point be used only as a special procedure (note dashed island shown in Exhibit 29). It is recommended that a second major entrance to the Fairgrounds be provided at the west parking area off of U.S. 87-212 on the west. The location of recommended widening and taking of right of way are shown in Exhibits 26 and 27, respectively.

North 13th Street and North 15th Street

Discussion of the east interchange to Interstate 90 pointed out the need for establishment of a pair of one-way streets to serve as a collector and distributor of traffic to and from the Interstate highway. The present capacity of the 13th Street underpass and approaches would not be sufficient to handle the interchange traffic. Investigation of the area led to the choice of North 15th Street as a feasible counterpart to North 13th Street for a pair of one-way streets.

The recommended improvements for the area are shown on Exhibit 22. The use of North 15th Street as the companion street for North 13th will require extensive work to provide continuity. At the point of crossing of the Northern Pacific Railway tracks between Montana and Minnesota Avenues, it will be necessary to underpass the tracks. Such an underpass will be feasible with some alteration and modification for drainage purposes in the area. Cost estimates have included such anticipated work. In addition, a new grade crossing of the C.B. and Q. Railroad tracks between Fourth and Sixth Avenues North will be required. New right of way will be needed between Minnesota and Montana Avenues and between the C.B. and Q. tracks and Sixth Avenue North. Capacity requirements call for widening of North 15th Street between First and Fourth Avenues North. Four lanes will be required between First Avenue North and Minnesota Avenue. Widening will be required on North 13th Street between Sixth Avenue North and Fourth Avenue North as well as between First Avenue North and the intersection with Minnesota Avenue. Minnesota Avenue will also require widening in the area to provide for future traffic. Extensive channelization will be needed to handle the movements occurring where the ramp terminals meet Minnesota Avenue and North 13th Street. The required widenings and taking of right of way are shown in Exhibits 22, 26 and 27.

NORTH-SOUTH ARTERIES

The primary arteries serving north-south traffic in the area of the new grid orientation are proposed to be Division Street, Fifth and Sixth Streets West, 15th Street West, 19th Street West, most of 24th and 32nd Streets West, Rehberg Lane, and 40th Street

West (Shiloh). Those streets designated as secondary arterials in this area are: Sugar Avenue, Riverside Road, Washington Street, Jackson Street, Hallowell Lane, Orchard Lane, Calhoun Lane, Billings Boulevard, Eighth Street West, Moore Lane, 12th and 13th Streets West, a portion of 15th Street West, 16th and 17th Streets West, a portion of 24th Street West, Canal Street, a portion of 32nd Street West, 37th Street West, and 38th Street West. In the area of original street orientation of the city, the major arteries are proposed to be: North 13th and 15th Streets, North 27th and 28th Streets, North 30th and North 32nd Streets; those of secondary nature are proposed to be: North 18th Street, a portion of South 24th Street, portions of North 25th, 34th and 35th Streets, and South 31st, 34th and 37th Streets.

These are shown as part of the recommended system on Exhibit 16. Some of the one-way pairs have been discussed in earlier sections; the remainder are covered below.

North 27th and 28th Streets

Earlier discussion has been directed toward the use of North 27th and 28th Streets as a one-way pair to alleviate the expected problem due to 1981 traffic demand in the central business district. It was apparent that this improvement will be required to upgrade service in the central business district without extensive construction along these streets, as would be necessary if two-way flow were to be retained. Furthermore, these facilities provide an acceptable route of travel between the South 27th Street interchange of Interstate 90 and the airport. The route chosen will require little modification of pavement widths or street layout. The only work to be done will be at each terminal of the pair to provide for transition from one-way to two-way flow. The required widening and right of way acquisitions are shown on Exhibits 26 and 27.

Fifth Street West - Sixth Street West

As noted in the section on critical areas covering Poly Drive and Grandview Boulevard, the congestion at the intersection of these streets with Fifth Street West can be reduced only by

eliminating certain of the movements and by making it possible for a portion of the traffic to bypass this intersection. Making Fifth Street West southbound--in combination with the one-way couplet of Poly Drive and Grandview Boulevard discussed earlier--will reduce the number of approaches to this intersection from five to three, producing a workable condition. This can be seen in Exhibit 25. Sixth Street West is the logical street to combine with Fifth Street West to form the required one-way couplet, and thus make it possible for traffic from the new underpass to proceed directly north on Sixth Street West. Reversing the usual direction of one-way traffic flow and making these streets operate as a left-handed pair is dictated by the conditions existing at the interchange area of Central and Montana Avenues as shown on Exhibit 28 and discussed in the section on critical areas. To repeat, the natural on-movement of Fifth Street West to Montana Avenue and the off-movement along the eastbound ramp to the underpass is such that to reverse it would introduce complicated connection problems. The use of one-way pairs at this location will also greatly simplify a condition which would require extensive reconstruction if handled in any other manner.

Much of the traffic from the central business district goes north to Poly Drive along North 27th or 32nd Streets and then west. The conversion of Poly Drive to one-way westbound operation between North 28th Street and Fifth Street West, therefore, will allow this traffic to flow smoothly through the intersection with Fifth Street West. This could not otherwise be accomplished with ease. In addition to North 27th and 32nd Streets, westbound traffic will use Broadwater, Lewis or Grand Avenues or Parkhill Drive, then proceed north on Sixth Street West and west on Poly Drive.

The locations of required widening along Fifth Street West and Sixth Street West are shown in Exhibit 26. Required acquisition of right of way can be seen in Exhibit 27.

Eighth Street West

In order to better serve traffic which would otherwise use Fifth and Sixth Streets West, Eighth Street West between Parkhill Drive and Central Avenue was chosen to provide a secondary facility

along this intensive north-south corridor. The facility would require four lanes for moving traffic. At the intersection with Grand Avenue and Broadwater Avenue, widenings will be required to provide sufficient capacity. This is because of the high volumes on these cross streets. Five lanes will be required crossing Broadwater Avenue and six lanes crossing Grand Avenue. The required widenings are shown in Exhibit 26.

15th, 16th and 17th Streets West

It is recommended that 15th Street West be designated a primary arterial and be upgraded accordingly. It will be necessary, therefore, to extend the facility across the B.B.W.A. Canal along new right of way to connect with Poly Drive on the north. Further, Regal Street and Daniel Street have been connected in the recommended plan, and designated as secondary arterials to provide continuity to the system south of Central Avenue. In between these extremities, connections have been made for 15th Street West between Grand and Lewis Avenues and Yellowstone and Broadwater Avenues. Widenings to provide four lanes are recommended along 15th Street West and the connecting secondary arterials south of Central Avenue. The designation of 16th Street West between Central and Grand Avenues and 17th Street West between Grand Avenue and Rimrock Road as secondary arterials will provide the lower level of through service required along the corridor between 15th and 19th Streets West. To provide the desired service upon inclusion in the system and in later years, it is recommended that provision be made for a minimum of two moving lanes and two parking lanes on each street.

The required widenings along these facilities are shown on Exhibit 26. The new right of way which must be acquired to obtain the desired continuity is shown in Exhibit 27.

19th Street West

It is recommended that 19th Street West be extended and improved to provide an additional continuous facility serving the north-south movements along the corridor between Fifth Street West and 24th Street West, as well as to provide access to the west interchange of Interstate 90. Some of the recommendations with regard

to 19th Street West have already been mentioned briefly in connection with the discussion of the west interchange area. The recommended improvements in the interchange area can be seen in Exhibit 21. Predicted traffic volumes will require four lanes between Poly Drive and the connections with the interchange. New right of way will be required for the extension between Central Avenue and King Avenue as well as new right of way and a bridge across the B.B.W.A. Canal south of Colton Boulevard. The extension of 19th Street West will continue southeast through the interchange and connect with Edward Street. The widening requirements are shown on Exhibit 26 and the sections across new right of way are indicated in Exhibit 27.

24th, 32nd and 40th Streets West

The 24th, 32nd and 40th Streets West facilities have been designated generally as primary arterial routes. Although 32nd and 40th Streets West fall outside the survey area, they have been included in order to indicate the desired spacing of the arterial network. This spacing is required to gain orderly and efficient distribution of traffic on the system. To provide the desired level of service for which they have been designated, it will be necessary to provide sufficient width for two moving lanes and two parking lanes. This cross section will also make it possible to obtain four moving lanes during peak periods. In order to up-grade these facilities, certain widening will be required; that which falls within the survey area is shown in Exhibit 26.

"Canal Street" and 37th Street West

As mentioned in the preceding section, it was necessary to carry recommendations beyond the study area in order to indicate desirable patterns in the system. Two facilities outside the survey area are classified as secondary arterials in Exhibit 16. The first is a new facility whose alignment follows the Billings Bench Water Association Canal, which shall hereinafter be referred to as "Canal Street". The second facility is 37th Street West. Canal Street is planned to run between Poly Drive and King Avenue, while 37th Street West is up-graded between Colton Boulevard and King Avenue. These facilities complete the pattern of arterial streets needed to obtain optimum efficiency in the network.

MAJOR EAST-WEST STREETS

West of the central business district, major arteries serving the Billings metropolitan area in the east-west corridor will be Rimrock Road; Poly Drive; Grand, Broadwater, Central and King Avenues; and a portion of Monad Road. Serving this east-west movement in a secondary manner will be Colton Boulevard, Parkhill Drive, Lewis Avenue and a portion of Monad Road. To the east, the major east-west arteries will be Sixth Avenue North, Fourth Avenue North, First Avenue North, Montana Avenue and First Avenue South on the older grid orientation; and State Avenue on the new grid orientation. Secondary service will be provided by Ninth and Eleventh Avenues North, Minnesota Avenue, Fourth Avenue South, Sixth Avenue South and Eighth Avenue South on the old grid orientation; and Vaughn and King Avenues and Kratz Lane on the new grid orientation. These can be seen in Exhibit 16.

West of Division Street, major east-west streets provide excellent service now, and could be up-graded to provide for future heavy movements. It was decided, therefore, that it will not be necessary to build additional streets or to couple any of the existing streets into one-way pairs. Modifications of east-west streets east of Division Street have been discussed in a preceding section on critical locations. Those facilities not discussed in that section are covered below.

First Avenue North - Montana Avenue

Detailed studies of the intersection of Division Street, First Avenue North and Broadwater Avenue as well as of the intersection of First Avenue North and North 28th Street show that not even the recommended system would be able to handle 1981 traffic. Diverting some of the traffic assigned to First Avenue North to Montana Avenue would merely create a problem on the latter. The existing problem of heavy left turn movements of eastbound traffic turning north along Montana Avenue and conflicting with southbound traffic would be aggravated. Similarly, major streets parallel to and north of First Avenue North would be at capacity without any intentional diversion of traffic from First Avenue North.

Further consideration of the problem led to the conclusion that use of First Avenue North as a one-way westbound street and

Montana Avenue as a one-way eastbound street between Division Street and North 21st Street, would take advantage of several important features of a one-way pair as discussed earlier. The two streets are parallel and separated by only one block. They serve the same kind of traffic. The transition from one- to two-way movement could be made quite easily at either end. On the west, a smooth connection of movements on First Avenue North and Montana Avenue could take place along the one-way section of Division Street connecting the two facilities; on the east, where Montana Avenue narrows and First Avenue North widens west of North 20th Street, a connection could easily be constructed between North 20th and 22nd Streets across land presently containing railroad spurs.

A comparative study was made of First Avenue North and Montana Avenue as either two two-way streets or as a pair of one-way streets. The resulting recommendations, the more significant of which are discussed below, are presented in Exhibits 23 and 24.

1. With the two-way system of streets, additional parking restrictions would be required along one side of First Avenue North.

2. The intersection of Broadwater Avenue, Division Street and First Avenue North would operate above design capacity under two-way operation unless there were extensive widenings requiring taking of right of way (including buildings).

3. The intersection of North 28th Street and First Avenue North would require extensive widening on First Avenue North in order to provide sufficient capacity. The heavy left turning movement from westbound on First Avenue North to southbound on North 28th Street would require two left turn lanes, calling for six lanes on the east leg of the intersection. To fit this cross section into the present right of way, it would require a widening of the pavement and a narrowing of sidewalks in an area where space is vitally needed for pedestrians. Similarly, the west leg of the intersection would have to be widened in order to provide five lanes.

One-way operation, on the other hand, will do with only four lanes operating somewhat below design capacity, thereby avoiding costly widening and permitting sidewalks to be wider.

4. Use of a one-way pair will simplify traffic signal timing from three to two phases at the intersections of North 27th Street and Montana Avenue and North 28th Street and First Avenue North, thereby reducing delay and allowing use of simpler and less expensive equipment.

It is recommended, therefore, that when traffic volumes warrant, that Montana Avenue and First Avenue North be converted to a pair of one-way streets.

Sixth Avenue North and Fourth Avenue North

Sixth Avenue North is an important primary artery in the street system of Billings. It serves presently as a distributor route for the downtown area, being on the north periphery. It handles traffic from Grand Avenue on the west and U.S. 10, 87 and 312 on the east. The intersection capacity along Sixth Avenue North threatens to become overtaxed under the presently committed system. However, when included in the recommended system with such improved parallel facilities as Fourth Avenue North, which will encourage more efficient distribution of traffic, Sixth Avenue North will operate within its design capacity with only peak-hour parking restrictions. Improvements will be required at the intersection with Division and North 32nd Streets on the west and in the area approaching the intersection with U.S. 10, 87 and 312. These improvements are discussed in detail in the section dealing with these critical locations. The improvements can be seen in Exhibits 22, 23 and 29. The widenings and necessary right of way takings are shown in Exhibits 26 and 27, respectively.

Fourth Avenue North connects with Lewis Avenue on the west and U.S. 10, 87 and 312 on the east. Since this facility runs through the core of the central business district, it is of major importance. When studied as a unit in the recommended system, Fourth Avenue North is found to provide sufficient overall capacity to serve at an acceptable level with four through lanes in peak periods. Although

no widening will be needed in the downtown area, parking will have to be restricted during peak hours. Improvements will have to be made at Division Street as shown on Exhibit 23. The improvements which will be needed in the area approaching U.S. 10, 87 and 312 are shown on Exhibits 22 and 29. These two areas have been discussed in greater detail in their respective sections.

Lewis Avenue

Lewis Avenue has been selected to provide secondary arterial service along the intensively traveled east-west corridor between Grand and Broadwater Avenues. The facility is recommended for up-grading between Division Street and 17th Street West. This will require widening in some sections to provide four lanes for peak period traffic and two traffic lanes plus parking lanes on both sides of the street during off-peak periods. It is expected that much of the overflow from Grand Avenue will be diverted to this facility as the downtown area is approached. Therefore, as volumes rise, Lewis Avenue will be an increasingly important route of access to the central business district. The required widenings are shown in Exhibit 26.

Recommended Street Improvements Along Grand Avenue

Grand Avenue is an important east-west artery. This is particularly significant in the light of projections which have shown that substantial growth of residential areas will take place along the western end of the facility.

Projected 1981 traffic on Grand Avenue and its cross streets will justify improvements along most of this street from Division Street to Rehberg Lane. Proposed improvements include minimum widening mentioned above in connection with the City Ordinance. The locations where additional street width will be required are shown in Exhibit 26, while additional right of way needed is shown in Exhibit 27.

Specifically, the recommended improvements call for:

1. Widening to six lanes between Division Street and Eighth Street West, thereby calling for additional right of way between Division Street and Fifth Street West.

2. The previously discussed widening to four lanes between Eighth Street West and Rehberg Lane, except where already provided between Colorado Street and 13th Street West.

3. Special widening and channelization to increase capacity at the intersections of Grand Avenue with 8th, 15th, 17th and 19th Streets West. This will require taking of right of way along Grand Avenue at each of these intersections.

Recommended Street Improvements Along Broadwater Avenue

Broadwater Avenue, already an important east-west facility, will become even more useful with expanding traffic and rising congestion on parallel arterials. Analysis of 1981 traffic assignments to the recommended system showed need for four moving lanes along the entire length of the facility between Division Street and 24th Street West. As mentioned above, this complies with the policy set forth in City Resolution Number 806. Recommended widenings and right of way acquisitions are shown in Exhibits 26 and 27, respectively. The proposed improvements between Fifth and Tenth Streets West along Broadwater are shown in Exhibit 28. Traffic capacity problems on Broadwater Avenue will require special widening and channelization at its intersections with 6th, 8th, 12th, 16th and 17th Streets West. The additional lanes required in order to operate at or below design capacity will require additional right of way at all of these intersections except 6th Street West.

Colton Boulevard-Parkhill Drive

A secondary facility will be required along the east-west corridor between Poly Drive and Grand Avenue. The streets chosen for this purpose are Colton Boulevard from 40th Street West to 17th Street West and Parkhill Drive from 17th Street West to North 32nd Street. Both streets will need some widening. A width of four lanes is recommended. These widenings are noted on Exhibit 26. In addition, Parkhill Drive should be realigned at its intersection with 13th Street West. There is presently a jog in Parkhill Drive at this intersection.

Rimrock Road

Rimrock Road, an important facility serving the northwest section of Billings, is designated as a major arterial in the recommended system. Analysis of predicted 1981 volumes showed need for four moving lanes, therefore, the four lanes as established in the City Resolution will be appropriate. The intersection of Rimrock Road with North 27th Street is the only one which will require special widening. At this intersection, three-lane approaches will be called for, thereby necessitating a 60-foot pavement width on Rimrock. To obtain this width of roadway will require acquisition of additional right of way. The treatment of this intersection is shown in Exhibit 25. The proposed widening and taking of right of way is shown in Exhibits 26 and 27, respectively.

Monad Road and King Avenue

On the southern border of the recommended system, King Avenue has been designated as a primary arterial serving the Interstate 90 interchange west of Billings. King Avenue is interrupted by U.S. 10-212 and the Northern Pacific Railway tracks at Edward Street. In order to gain continuity in the system, King Avenue should be extended easterly as a secondary arterial beyond its intersection with 19th Street West and joined with the Regal-Daniel Street connection with 15th Street West. To the east of the interruption of King Avenue, the facility will act as a secondary arterial forming the border of the system and serving the portion of the city south of the central business district. It is proposed to extend it as a secondary arterial to Garden Avenue to provide continuous movement to Belknap Avenue. From Belknap Avenue a connection has been planned to the Interstate 90 interchange east of Billings. North of King Avenue, at desirable spacing, Monad Road has been designated as the next arterial facility on the west side of the city. The portion between Moore Lane and 24th Street West will be a primary arterial whereas the section from 24th Street West to 40th Street West has been recommended as a secondary arterial. On the east, Monad Road will connect with the facility presently being constructed alongside U.S. 10-212 in order to enable traffic to reach Sixth Street West and State Avenue.

Widenings to up-grade these facilities to the level of service desired are shown in Exhibit 26. This will require provision for two moving lanes with two parking lanes capable of being converted to traffic lanes at intersections and along some blocks during peak periods.

Minnesota Avenue, First Avenue South and State Avenue

Proceeding westerly from the connection with the interchange on Interstate 90 east of Billings, Minnesota Avenue will serve as a primary route until it meets First Avenue South. At this point, Minnesota Avenue will serve as a secondary route along the Northern Pacific Railway tracks, while First Avenue South, having more continuity, will take on primary status until merging with State Avenue. Along the route described, access will be provided to and from the north side of the tracks at South 13th and 15th Streets; South 21st Street; South 27th and 28th Streets; and South 29th Street. Widening will be required between South 13th and 20th Streets along Minnesota Avenue to provide four lanes when peak hour parking restrictions are in force. Along First Avenue South, similar widening will be required between South 20th and 22nd Streets.

State Avenue has been designated as a primary arterial intercepting each of the streets on the old grid orientation. It will serve as a major collector-distributor facility for east-west traffic with origins or destinations in the business area south of the tracks. State Avenue will also serve as the major east-west access route to the South 27th Street interchange with Interstate 90. Widening will be necessary to provide the required capacity between First Avenue South and South 27th Street.

The proposed widening and right of way takings are shown on Exhibits 26 and 27, respectively.

Poly Drive

Poly Drive has been designated as a primary arterial between 38th Street West and North 27th Street. This facility will be carrying an increasing volume of traffic as anticipated growth takes

place to the west. The section between North 28th Street and Fifth Street West is suggested to be a one-way westbound street coupled with Grandview Boulevard. This has been discussed in more detail in the section dealing with this critical location. Along the remaining portion of the arterial, widening will be required to provide four moving lanes. The proposed widenings are shown on Exhibits 25 and 26.

OTHER ARTERIALS

In order to have a complete system of arterials and to provide the desired continuity in the system, certain other secondary arterial facilities have been designated on the recommended plan. To the west of the downtown area, 12th Street West between Central and Grand Avenues together with 13th Street West between Grand Avenue and Rimrock Road have been designated as secondary arterials to provide service along the corridor between 8th and 15th Streets West. Farther west, as a continuation of 37th Street West, 38th Street West has been designated as a secondary facility between Colton Boulevard and Rimrock Road. Immediately to the north of downtown Billings, 9th and 11th Avenues North are the logical choice for desired spacing of secondary arterials. Likewise, North 18th and 25th Streets will provide desirable secondary service. South of the Northern Pacific Railway tracks, Fourth, Sixth and Eighth Avenues South have been designated as the secondary arterial facilities to handle east-west movements on streets with the old orientation; and South 31st, 34th and 37th Streets will serve the north-south traffic in this area. Below this section, in the area with the newer street pattern, Billings Boulevard, Calhoun Lane, Orchard Lane, Hallowell Lane, Jackson Street, Washington Street, Riverside Road and Sugar Avenue are the designated facilities comprising the north-south arterial system in this southern area. It is recommended that each of these facilities be up-graded to provide the width of pavement which will allow conversion from two lanes with parking to four lanes without parking when and where needed. The required widenings are shown in Exhibit 26.

The combination of these facilities with those discussed in the previous sections will provide a regular and continuous pattern of arterials to serve traffic in the Billings metropolitan area.

TESTING THE SYSTEM

In order to judge the efficiency of the recommended system and to measure the overall level of service, a series of capacity analyses were carried out at the critical intersections throughout the study area. The results of these analyses are shown on Exhibit 30. Whereas Exhibit 15 shows that the presently committed system would be operating with a majority of these arterial intersections well above design capacity, the recommended system would have a small minority of these operating at or just above design capacity. Where design capacity of intersections on the recommended system appeared to be exceeded, the assigned volumes were questioned. The method of computer assignment of the traffic to the system was such that traffic was not assigned to parallel collector streets nor to some secondary arterials. Therefore, the computer put this traffic on the nearest primary arterial. This manner of assignment tends to overstate anticipated volumes. It is our opinion, therefore, that within the accuracy of the assignment to individual facilities, the recommended system will operate satisfactorily with estimated 1981 traffic volumes. It can be said further that the system as proposed in this report will result in an operation which approaches a minimum of delay and a maximum of return on the investment in the system.

Chapter IX

COST ESTIMATES AND CONSTRUCTION STAGING

Estimates have been made of the cost of street improvements and extensions required to complete the recommended arterial street system described previously in the report. Each section of the recommended street system was analyzed in detail to determine the extent and type of improvements necessary. For purposes of estimating cost, the recommended system was divided into approximately 240 segments. These were later combined into approximately 80 items on the basis of type of street and assigned priority of construction.

Basic Assumptions

Cost estimates were based on 1962 contract bid prices furnished by the city, as well as the most recent prices available for similar improvements in other cities. They include an allowance of 20 percent for engineering and contingencies. In addition, the following general assumptions were made with regard to type and method of construction:

1. Existing pavement on the recommended arterial street system which appears on visual inspection to be structurally unsound will be removed or crushed and reused as a subbase.

2. In instances where widening is required, where the existing pavement is to be removed or replaced, or where there is no existing pavement, a new subbase course will be provided together with new base and surface courses as follows:

Type of Street	Type of Traffic	Surface Course	Base Course
Major I	Large traffic volumes Heavy truck traffic	3" bituminous concrete	9" Portland cement concrete
Major II	Large traffic volumes Light truck traffic	2" bituminous concrete	7" Portland cement concrete
Secondary	Medium traffic volumes Few or no trucks	2" bituminous concrete	9" semi-graded crushed base

3. Existing pavement on the recommended arterial street system which appears on visual inspection to be structurally sound will be retained as a base and resurfaced with a new prime coat, leveling binder and bituminous concrete surface course.

4. Sidewalks, trees and other obstructions will be removed, as required, for the widening of existing streets.

5. New curbs and gutters will be constructed of Portland cement concrete.

6. New concrete sidewalks will be five feet wide.

7. Driveways will be improved or constructed as required.

8. On streets presently served by storm sewers, adjustments will be made to manholes and drainage structures, if required.

9. New storm sewers will be provided throughout the recommended arterial street system where none exist as well as in street extensions. In this respect, new storm sewers have been considered part of the general up-grading of streets included in the recommended arterial network. Additional connections may be required to complete an integrated storm sewer network, but the extent of such additional service is beyond the scope of this report.

10. Shoulders, when specified, will be stabilized to support standing vehicles.

11. Railroad crossing improvements (but not protection), culverts, bridges, unusual earthwork and other special items of construction will be provided where necessary.

12. The cost of additional right of way for street widening, intersection improvements, etc., have been estimated on the basis of valuations provided by the city. It was assumed, however, that new right of way for street extensions in presently undeveloped areas will be acquired through dedication.

Costs Not Included In Estimates

The following items have been omitted in estimating the cost of recommended improvements:

1. Costs of adjusting or improving street lighting, utility poles, water supply systems, hydrants, sanitary sewers or underground utilities. These costs, we believe, are not appropriately chargeable to the street improvement program and should be paid for from separate funds.

2. Costs of traffic signs (except signing required for one-way streets), signals or pavement marking. The need for such items is so variable that a reasonable cost estimate could not be made at this time. These costs should be nominal, however, in relation to the cost of other improvements, and might be met from the contingency allowance.

Estimated Cost of Improvements

The estimated total cost of improvements (excluding right of way) to implement the previously described arterial street system would be slightly over $20,000,000 at 1962 price levels. See Table 15. Of this amount, however, approximately $4,800,000 would qualify for federal,

state or county assistance. Federal participation amounting to about $2,700,000 can be anticipated for improvements on federal and state highways. Matching funds provided by the state, county and city on such routes, it has been estimated, would amount to approximately $2,100,000. The city's share of such costs has not been determined.

Tentative Priority Ratings

Suggested tentative priority ratings for each improvement in the recommended arterial street system are shown in Exhibit 31. Table 16 shows cost estimates for each proposed street improvement (excluding right of way), by priority rating, as well as the type of street and range of present and proposed street and right of way widths. Table 15 summarizes total estimated cost of improvements (excluding right of way) in each tentative priority group.

Table 17 summarizes the estimated cost of right of way acquisition for improvements included in the recommended arterial street system. It has been estimated that the total cost of acquisition of right of way, at 1962 price levels, would be $1,100,000. Of this amount, $345,000 would be required for street extensions, $273,000 for widening existing streets, and $482,000 would be required for channelization at intersections. Table 17 also shows the tentative priority rating of each project for which new right of way is required. See Exhibit 27 for location of new right of way requirements for the recommended street improvements.

Priority ratings have been designated as tentative since the scheduling of proposed street improvements must be closely coordinated with other projects. For example, the status of proposals for new parks and schools, or perhaps new shopping centers or industrial areas, might make it desirable to advance or delay a particular street improvement. The schedule for implementing the recommended improvements should be reviewed in detail at frequent intervals in order to assure its continuing propriety with regard to evolving land use patterns; relocation or establishment of state and federal highways; and other pertinent factors.

Projects shown as having first priority should be planned and constructed as soon as possible. Such projects include the initiation

and construction of one-way streets (except North 13th and 15th Streets); improvement of all intersections on major streets at which analysis of traffic data indicated the need for widening or additional lanes; improvement of east-west arterial streets providing access to the central business district; and improvement of 16th and 17th Streets West. In addition, other relatively minor improvements designed to ease traffic movement in and near the downtown area have been included in the first priority.

Almost three-quarters of the total estimated expenditure required for additional right of way would be attributable to projects shown as having first priority. See Table 17. Since these costs may be expected to increase due to new construction, it is suggested that acquisition be started as soon as possible. This would apply particularly to presently vacant tracts which will be required for street extensions or for straightening the alignment of major streets.

Improvements listed under second priority should be planned now for construction as soon as possible after completion of the first priority. These projects include improvement of east-west arterial streets to serve outlying areas as well as improvement and extension of 8th, 15th and 24th Streets West. Also included in this priority is the construction of the proposed east Interchange on Interstate 90 together with completion of North 13th and 15th Streets as a one-way couplet.

Third priority projects include the improvement and extension of a number of secondary streets as well as up-grading and extension of various other facilities destined to assume the status of major streets as expected growth of the Billings urban area occurs.

Projects in the fourth priority include improvement and extension of secondary streets required to provide access to residential areas expected to show marked growth over the next two decades.

While the recommended street system described in this report provides for extension beyond the external cordon line, estimates include only the cost of recommended improvements within the internal survey area.

Financing the Improvements

The arterial street system described in this report has been planned to meet the needs of the area through the next two decades. It is recommended, however, that the program be implemented as rapidly as possible within the financial capabilities of the city.

It should be noted that costs of recommended improvements are not entirely an addition to the regular expenditures of the city. Many of the improvements would normally have been budgeted in the city's continuing program of street maintenance. In addition, as shown in Table 15, federal, state and county financial participation may amount to approximately one-fourth of the total cost of the recommended system.

Estimates have also been based on construction of each improvement as a separate project. A reduction from the estimated total cost may be realized, however, by grouping minor improvements into single large construction projects.

Standards should be established and adhered to rigidly--especially with regard to pavement and right of way widths. Close cooperation and teamwork will be needed to assure scheduling of improvements in such a manner that they will complement each other and form a unified system. It may be necessary from time to time to adopt temporary expedients--such as peak-hour parking restrictions--in order to increase traffic capacity on various segments of the system before funds become available for ultimate improvements. In such instances, however, the standards set forth in the recommendations should not be compromised, and the improvements should be completed as soon as other more urgent projects have been finished.

It has been estimated that about $17,000,000 in city funds will be required to acquire right of way and construct the recommended street system. (Only about $175,000 of the estimated $1,100,000 required for additional right of way would be eligible for federal, state or county financial participation.) Assuming that the expenditure is spread evenly over a period of twenty years, the average annual outlay would be slightly over $800,000 per year. Average population of the internal survey area during the next two decades, it has been estimated, will be about 80,000. The cost in city funds, therefore, will average approximately $10.00 per capita per year.

Chapter X

PUBLIC TRANSIT

In developing the recommended transportation system for Billings, consideration was given to achieving maximum coordination between highway and public transport facilities. The primary purpose was to develop a transportation system which would exploit the advantages of both the automobile and the public bus system while minimizing the inherent disadvantages of each.

The bus system, to serve its function in Billings properly, should retain its present patronage and attract a proportionate share of the future increase in person-travel. Comfortable buses, dependable service, and reasonable fares should assure that a substantial number of daily trips will continue to be made by bus. Transportation planning should proceed on the basis of providing a balanced transportation system for physical and economic reasons.

Existing Public Transit

Public transit in Billings is currently rendered exclusively by motor bus. The Western Transit Company operates a fleet of comfortable buses, with fairly frequent service to most areas, especially during peak periods. Some of the routes follow a winding course in order to serve as many neighborhoods as feasible.

Notwithstanding the comfortable equipment and relatively good standard of service offered, Billings is essentially an auto-dominant community. The 1961 origin-destination survey revealed that of 219,258 total person-trips in the metropolitan area on a typical weekday, 98.4 percent were made as passengers or drivers of motor vehicles including taxis and trucks, while only 1.6 percent were made by bus. The latter figure includes school children's use of special school buses.

The transit riding data used in this report were obtained from the Dwelling Unit Interview survey taken in August, September, and October, 1961. The following figures, including those in the tables, are for trips as actually reported, without expansion. They show relative use of buses for various purposes, therefore, rather than the total number of trips made by bus in each category. Reporting of bus trips by people interviewed was well below actual numbers as determined from other sources, which is not uncommon. Expansion of the 333 reported bus trips by dwelling unit expansion factors (Table 4) resulted in 1,977 trips at the 1961 level of riding. This table was further expaned to 3,050 trips in 1961, on the basis of data furnished by the transit company.

School trips accounted for 89 of the 333 trips by bus reported by persons interviewed during the survey. Of the remaining trips, 48 were made by men and 196 by women. Twelve of the foregoing 48 trips were made by men who did not own a car; therefore only 36 of 333 trips by bus were made by men who might have had a car available. One hundred eighty-seven of the 244 persons making trips came from families owning an automobile. See the following table for purpose of trip information:

DISTRIBUTION OF PERSON-TRIPS BY BUS
BY SEX AND BY PURPOSE OF TRIP

Purpose of Trip	Male	Female	Total
Work	32	108	140
Personal business	3	23	26
Medical-dental	0	13	13
Social-recreation	8	13	21
Change mode of travel	0	2	2
Eat	0	2	2
Shop	5	35	40
Sub-Total	48	196	244
School	46	43	89
Total	94	239	333

The following table gives information pertaining to availability of automobiles:

DISTRIBUTION OF BUS TRIPS
BY PURPOSE OF TRIP
AND AVAILABILITY OF AUTOMOBILE*

Purpose of Trip	Automobile Available	Automobile Not Available	Total
Work	115	25	140
Personal business	12	14	26
Medical-dental	11	2	13
Social-recreation	19	2	21
Change mode of travel	2	0	2
Eat	2	0	2
Shop	26	14	40
Total	187	57	244*

*-Excludes the 89 school trips

The general trend of transit riding in Billings was downward from 1953 to 1961. Between 1961 and 1962, however, there was a six percent increase in passengers to an average of 3,050 per day.

Exhibit 32 is a flow chart showing the volume of bus passengers outbound from the central business district in 1961.

Population characteristics of areas found to have relatively high transit riding were compared with those of areas contributing few trips by bus. See the following table:

COMPARISON OF POPULATION CHARACTERISTICS
IN AREAS WITH LOW AND HIGH TRANSIT RIDING

Population Characteristics	Percent of All Transit Riders	
	Areas with Low Transit Riding	Areas with High Transit Riding
Sex:		
Male	50.8	47.8
Female	49.2	52.2
Age Group:		
Less than 20 years old	46.9	39.2
20 - 30 years old	8.2	11.5
30 - 65 years old	40.6	40.6
65 years old and older	4.3	8.7

It was found that high transit riding areas had higher-than-average percentages of females and older people. This appears to reflect the higher use of transit services by women shoppers and older people not owning cars, i.e. "transit captive" passengers. It also agrees with experience in other cities.

Future Public Transit

Recommendations as to the future form of public transit in Billings must consider the existing situation as outlined above, as well as current trends and potential development.

A decline in the patronage of public transit systems is occurring in most cities of Billings' size. There has been a corresponding increase in motor vehicle ownership and usage. Indications are that this decline of riding will continue, although patronage appears to have reached an irreducible minimum in some cities, short of abandonment of all service.

Growth factors were developed so that the 1961 transit riding could be expanded to reflect increases in population and commercial activity expected by 1981. The next consideration was the manner in which the needs of the estimated 1981 transit riding would be met. Recent increases in transit riding appear to have come about as a direct result of the increase in the type of service provided. Convenience, comfort and economy are the all-important factors. The "Ride-'n-Shop" plan recently inaugurated in Billings recognizes these factors.

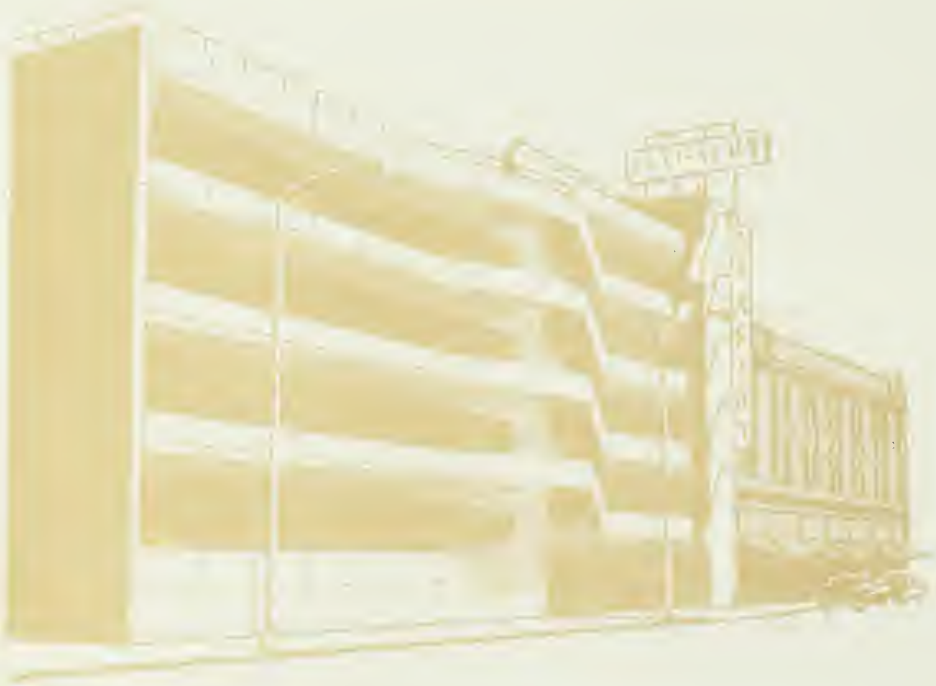
The final step in the transit study was to plan a bus system appropriate to serve the needs of Billings in 1981. Where there are now two or more bus lines operating within a short distance of each other, it is proposed that there be one consolidated route operating on an arterial street. This will provide more direct and faster travel to and from the downtown area. All three of the west side lines are proposed to be routed so as to serve the large shopping center on Grand Avenue at 16th Street West. The growing areas to the west and south will require extensions, and all services will be through-routed under the proposed plan.

In order to reflect more realistically the expected 1981 transit riding, induced traffic was assigned to certain zones receiving new or improved transit service in the 1981 plan. Two zones (442 and 452) were projected to generate fewer bus trips than they would on the basis of their expected population in 1981 because of their distance from bus lines and isolation by the new Interstate route.

It is estimated that 5,288 bus trips will be made on an average day in 1981. Table C-4 (1981) shows the estimated 1981 volumes of bus passenger trips on a zone-to-zone basis. Table C-4 (1981) was prepared to project public transit riding only. It does not include school bus trips shown in Table C-4 (1961) of the Traffic Data Book. Also note that zone-to-zone person trips shown in Table C-1 (1981) do not reflect additional adjustments of reported transit trips made on the basis of data provided by the transit company. The estimated 5,288 bus trips in 1981 corresponds with 3,050 such trips in 1961 and represents an increase of about 73 percent.

Exhibit 33 shows the estimated 1981 average weekday transit riding from the central business district to each outer zone.

In summary, it can be said that with continued emphasis on up-grading of transit service through such programs as the "Ride-'n-Shop" plan, it should be possible to gain increased patronage in the future. Continuing support by the people of Billings and their elected representatives will be necessary to attain this goal.



Chapter XI

PARKING STUDIES

The survey area (sometimes referred to as the central business district) was bounded on the north and south by the tracks of the Northern Pacific Railway; on the east by North 23rd Street; and on the west by North 32nd Street. See Exhibit 34. Approximately 49 square blocks were included.

The survey area was selected to correspond with the "zero sector" defined in the concurrent origin-destination survey. Block numbers (or zone numbers) referred to in the parking report correspond with sub-zone numbers established in the origin-destination survey.

After compilation of the survey data, it was possible to determine a core area for further use in analysis of the study. The core area, also shown in Exhibit 34, was bounded by Montana Avenue on the south, North 29th Street on the west, Third Avenue North on the north, and North 26th Street on the east.

Parking studies were made in accordance with procedures set forth in the "Parking Study Manual - Instructions for a Comprehensive Study", published by the Department of Commerce, Bureau of Public Roads. Slight modifications were made, where necessary, to assure that results of the parking study would be directly comparable to data obtained in the origin-destination survey made at the same time.

An inventory was made of all parking spaces at the curb, as well as those in lots and garages. The curb inventory included the number of spaces and their location along each curb face; time restrictions; locations of truck, bus and taxi loading zones; and the equivalent number of parking spaces in areas where parking was

prohibited. At off-street facilities, the inventory included the number of spaces and type of facility as well as rates charged for parking and the general layout of each lot and garage.

Parking habits and desires of motorists who parked in the area were revealed by interviewing users of each space. At some curb faces and lots where usage was slight, return postcard interviews were substituted for personal interviews. Interviews were designed to determine type of vehicle, type of parking, time of entering and leaving the space, and trip origin, destination and purpose. Interviews were made at each curb or off-street facility during a nine-hour period between 9:00 A.M. and 6:00 P.M. on weekdays only.

Manual classification counts were made of the number of vehicles entering and leaving the survey area on an average weekday. These were made at each point where a street intersected the theoretical cordon line enclosing the survey area.

Data acquired in the parking study were coded and punched into statistical tabulating cards to facilitate office tabulation and analysis. The resulting tables have been presented previously in our report entitled "Basic Data on Parking".

THE SUPPLY OF PARKING SPACE

The inventory of parking spaces included all spaces at the curb, as well as those in lots and garages in the survey area.

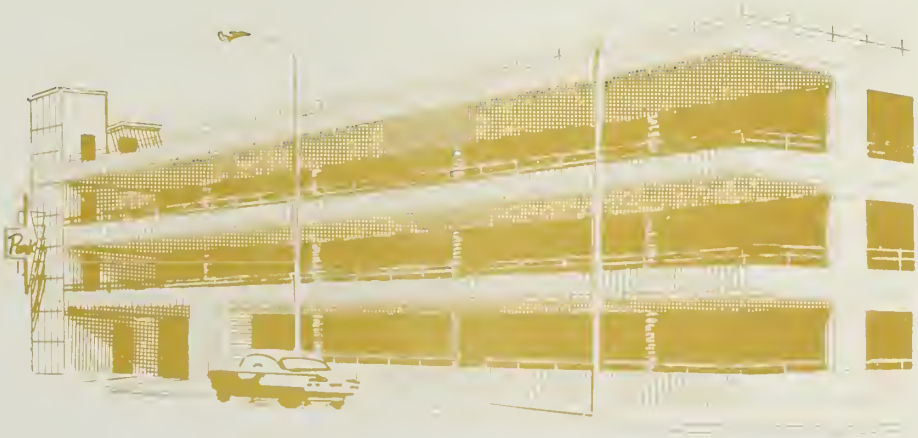
The inventory of curb spaces consisted of field investigation of the number, type, location and time restrictions of spaces along each curb face. Locations of restricted spaces and prohibited curbs, as well as truck, bus and taxi loading zones, were recorded and subsequently converted into equivalent parking spaces.

The location, capacity and type of each off-street facility were also recorded, along with other pertinent data such as layout and rates charged for parking.

At the time of the study, there were the equivalent of 2,501 curb parking spaces in the survey area. Parking was prohibited at 743 curb spaces and 160 others were designated as loading zones. An additional 10 spaces were reserved for special use, leaving 1,588 curb spaces available to the general public. A total of 902 curb spaces, or 57 percent of those available to the general public, were metered. Table 1-A in the Parking Data Book shows a tabulation of the number of curb parking spaces at each curb face in the survey area. Locations of curb parking spaces are shown in Exhibit 35.

There were 123 parking lots and three parking garages in the survey area with a combined capacity of 3,051 cars. A total of 1,466 spaces were in commercial, metered and customer lots and commercial garages. The remainder were in monthly-only, employee or private-use facilities. The number of off-street parking spaces in each zone in the survey area is tabulated in Table 1-B of the Parking Data Book. Their locations and capacity are shown in Exhibit 36.

The table on the following page summarizes the number and type of all curb and off-street parking spaces in the survey and core area.



INVENTORY OF CURB AND OFF-STREET PARKING SPACES IN THE SURVEY AND CORE AREAS
1961

Type of Space	Number of Spaces: Survey Area		Number of Spaces: Core Area	
Curb:				
No Restriction	406		-	
2-Hour Free	174		-	
30-Minute Free	9		-	
10-Minute Free	20		5	
2-Hour Metered	348		15	
1-Hour Metered	503		230	
12-Minute Metered	51		25	
Miscellaneous	77		9	
Special Permit	10		2	
Loading Zone	160		63	
Prohibited Curb	743		132	
Total Curb	2,501		481	
Total Available Curb*		1,588		284
Off-Street:				
Parking Lots:				
Commercial	24		-	
Metered	645		48	
Customer	359		32	
Monthly Rental	1,025		104	
Employee	353		123	
Private Use	194		27	
Garages:				
Commercial	438		438	
Private	13		13	
Total Off-Street		3,051		785
Total Available Curb and Off-Street*		4,639		1,069

*-Excludes prohibited curb, loading zone and special permit curb spaces.

On a weekday, during the period between 9:00 A.M. and 6:00 P.M., there were 41,371 parking space-hours available in the survey area. Space-hours of parking supply are defined as the number of available parking spaces multiplied by the number of hours during the study when parking is permitted.[1]

TRAFFIC MOVEMENT AND ACCUMULATION

Manual classification counts were made between 9:00 A.M. and 6:00 P.M. on all streets crossing the parking cordon line. Results of the cordon count are presented in Table 2 of the Parking Data Book and shown graphically in Exhibit 37. The following table summarizes results of the cordon count for the nine-hour survey period.

VEHICLES ENTERING AND LEAVING
THE SURVEY AREA BETWEEN
9:00 A.M. AND 6:00 P.M. ON A WEEKDAY

	Number of Vehicles
Entering	
Cars (Including Taxis)	27,114
Trucks	5,843
Total	32,957
Leaving	
Cars (Including Taxis)	27,776
Trucks	6,003
Total	33,779

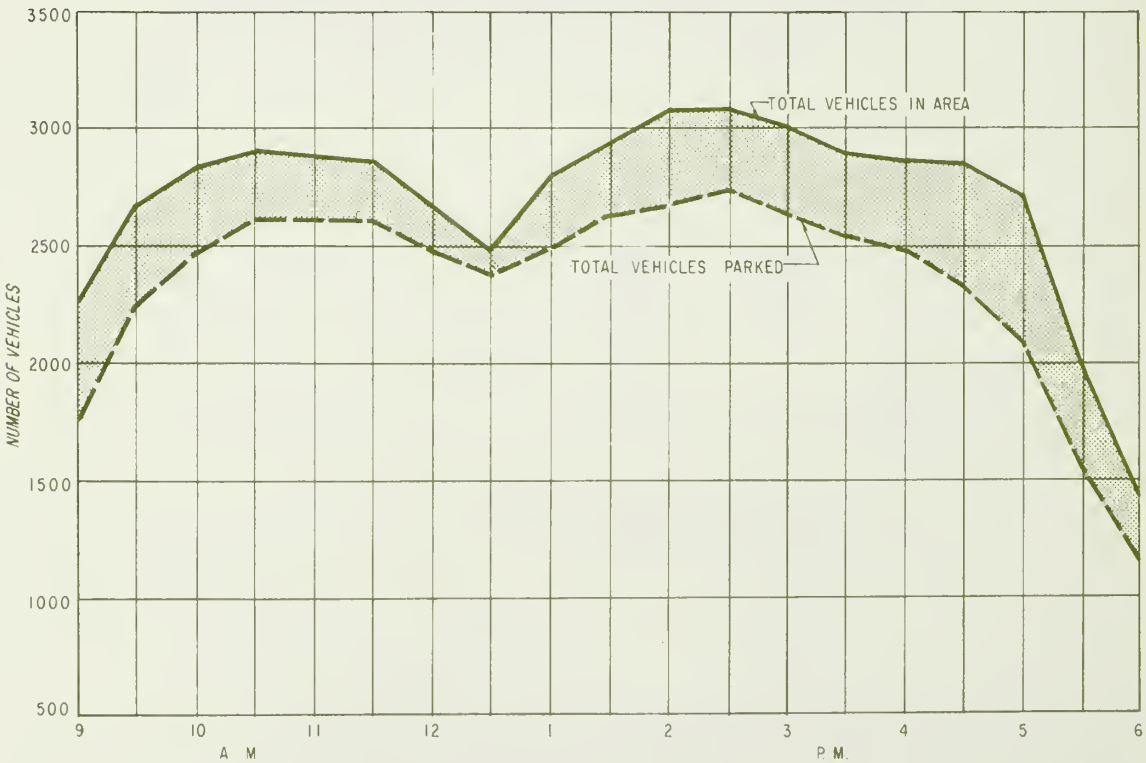
[1]The number of available space-hours is not equal to nine times the number of available spaces due to restrictions on the use of some spaces during various hours of the day and various days of the week.

A total of 66,736 vehicles crossed the cordon line between 9:00 A.M. and 6:00 P.M., of which 11,846, or 17.7 percent, were trucks. Peak accumulation occurred between 2:00 P.M. and 2:30 P.M. when there were approximately 3,080 vehicles in the area. The peak hour of traffic movement was from 4:30 P.M. to 5:30 P.M. when 10,538 vehicles, or 15.8 percent of the nine-hour total, crossed the cordon line.

Accumulation of vehicles parked in the survey area was determined from times of entering and leaving parking spaces reported in the interviews. Tabulations of parking accumulation by type of vehicle and type of space are shown in Tables 4 and 5, respectively, of the Parking Data Book.

Figure 22 shows a comparison between total vehicles accumulated and those parked in the survey area. The shaded area between the two accumulation curves represents the number of vehicles passing through the area as well as those destined for or in search of

FIGURE 22



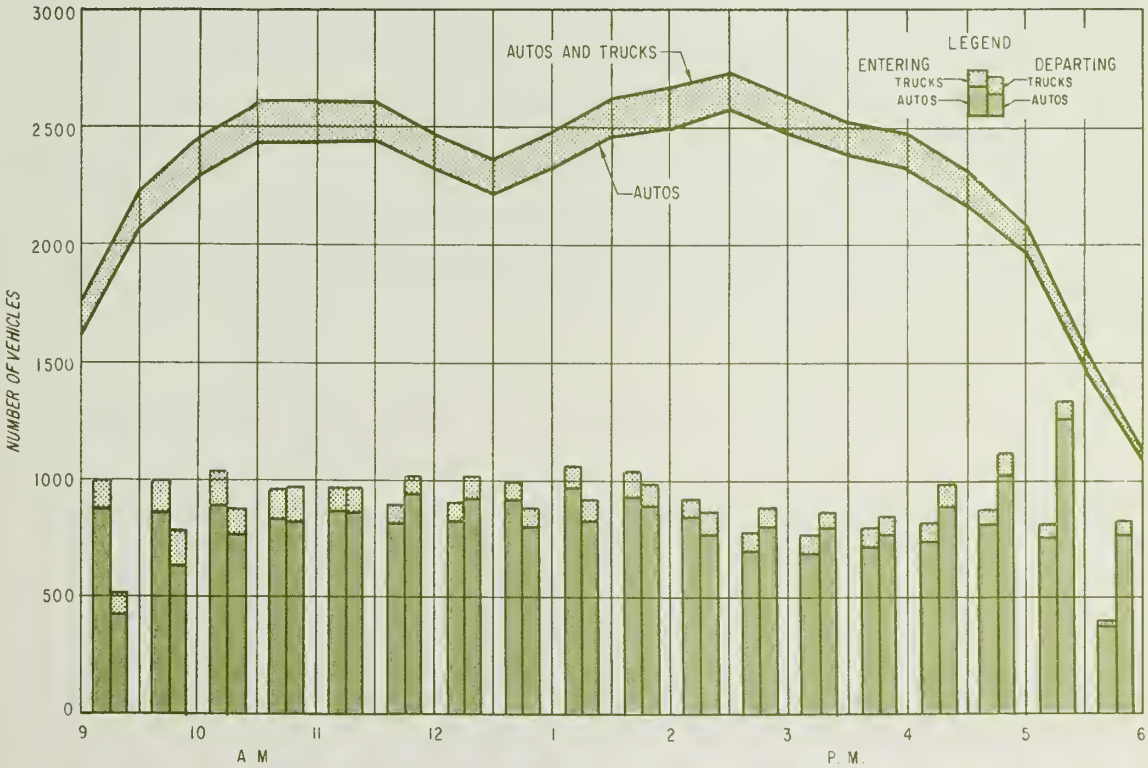
ACCUMULATION OF VEHICLES IN THE SURVEY AREA COMPARED WITH PARKING ACCUMULATION

a parking space, or those who had left their parking space but had not yet crossed the cordon line. It can be seen that the number of vehicles accumulated in the area but not parked remained nearly constant throughout the day except during the mid-day period from 11:30 A.M. to 1:00 P.M. Many motorists were having lunch during this period.

Accumulation of vehicles parked in the survey area is shown in Figure 23. Peak accumulation occurred between 2:00 P.M. and 2:30 P.M. when 2,736 vehicles were parked. These occupied 59 percent of available parking spaces. Of the vehicles parked at the period of peak accumulation, 1,163 were parked at the curb and 1,573 in off-street facilities, utilizing 73.2 percent of available curb spaces and 51.6 percent of off-street spaces.

Parking accumulation in the core area is summarized by type of vehicle and type of space in Tables 4-A and 5-A, respectively, of the Parking Data Book. Peak parking accumulation in the core area occurred between 2:00 P.M. and 2:30 P.M. when 670 vehicles were parked. Peak percentage occupancy was 62.6 percent of available spaces. Peak

FIGURE 23



ACCUMULATION OF VEHICLES PARKED IN THE SURVEY AREA AS WELL AS ENTERING AND DEPARTING MOVEMENTS

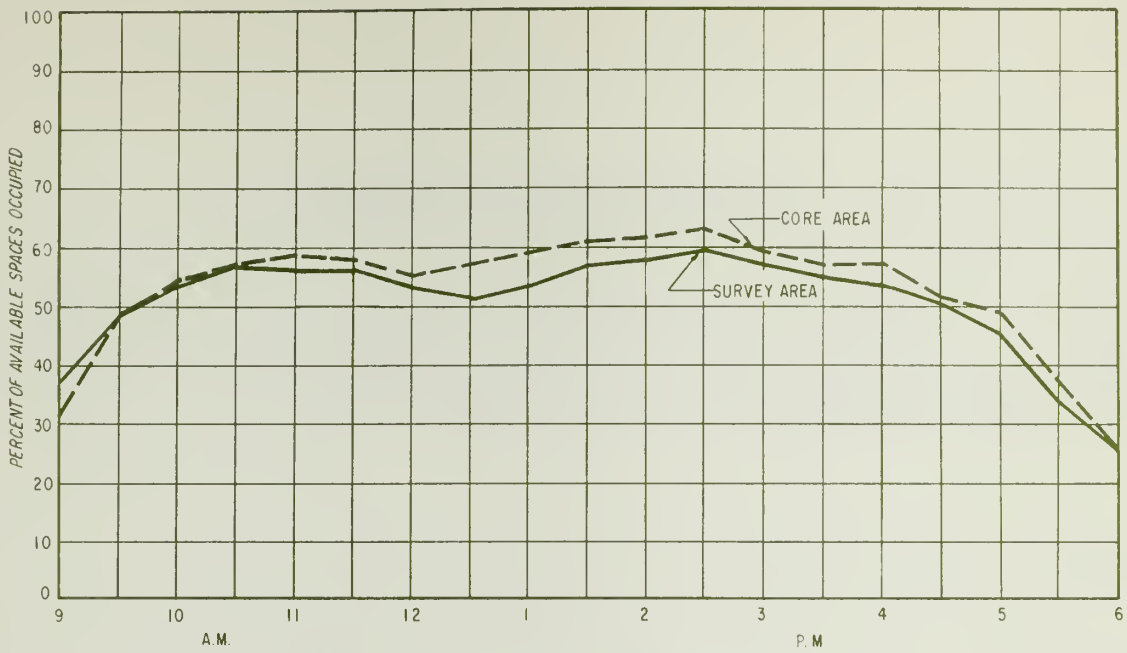
occupancy of curb spaces in the core area was 94.0 percent, while that of off-street spaces reached 51.3 percent. Figure 24 shows a comparison of accumulation of vehicles parked in the core area with those parked in the entire survey area.

An additional study was made of parking accumulation on a Saturday. At hourly intervals, field personnel counted the number of vehicles parked in all curb spaces as well as in 18 off-street facilities with a combined capacity of 829 spaces. A total of 2,427 spaces were included. Figure 25 shows the comparison of weekday and Saturday parking accumulation in the spaces studied. Weekday accumulation was consistently higher hour for hour, than on Saturday--particularly during the afternoon.

Studies of traffic movement and accumulation showed that there were always a considerable number of vacant parking spaces in the survey area. It is generally assumed that optimum peak occupancy of curb spaces should approximate 90 percent of capacity while that of off-street facilities should be about 85 percent. The additional margin of supply over demand is required to meet above average demand[1] as well as to provide for the inevitable lapse in time between the departure of one vehicle and arrival of another. Except at curb parking spaces in the core area, accumulation of parked vehicles in the Billings central business district was substantially lower than these optimum levels. Availability of a parking space, however, is a function of the distance of the space from the motorist's destination. As will be shown later in the report, many of the vacant spaces indicated in the accumulation summary are far removed from centers of parking demand.

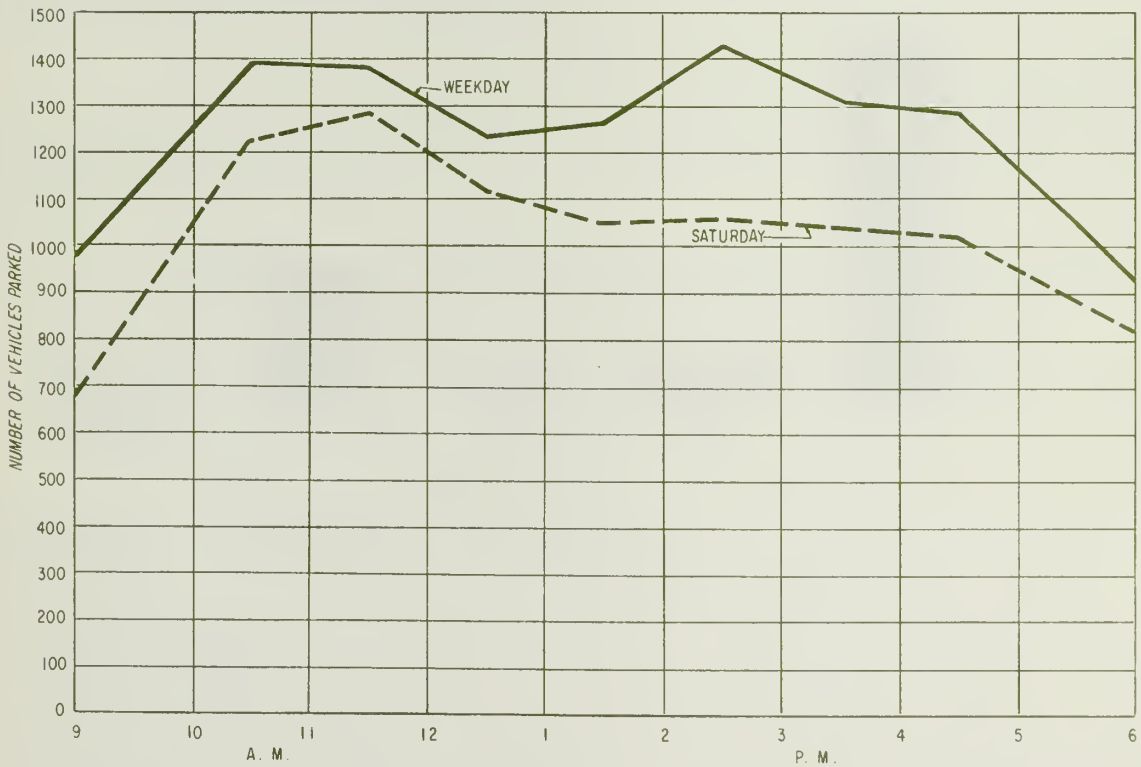
[1]There will be many days during the year when parking demand is slightly above normal (say up to five percent greater than on an "average" day). Under satisfactory operating conditions, these above normal demands can be absorbed, but some delay or inconvenience is possible. The margin of supply over demand provided under optimum operating conditions, however, would not be adequate to meet peak demands during holiday seasons.

FIGURE 24



COMPARISON OF PARKING ACCUMULATION IN THE SURVEY AND CORE AREAS

FIGURE 25



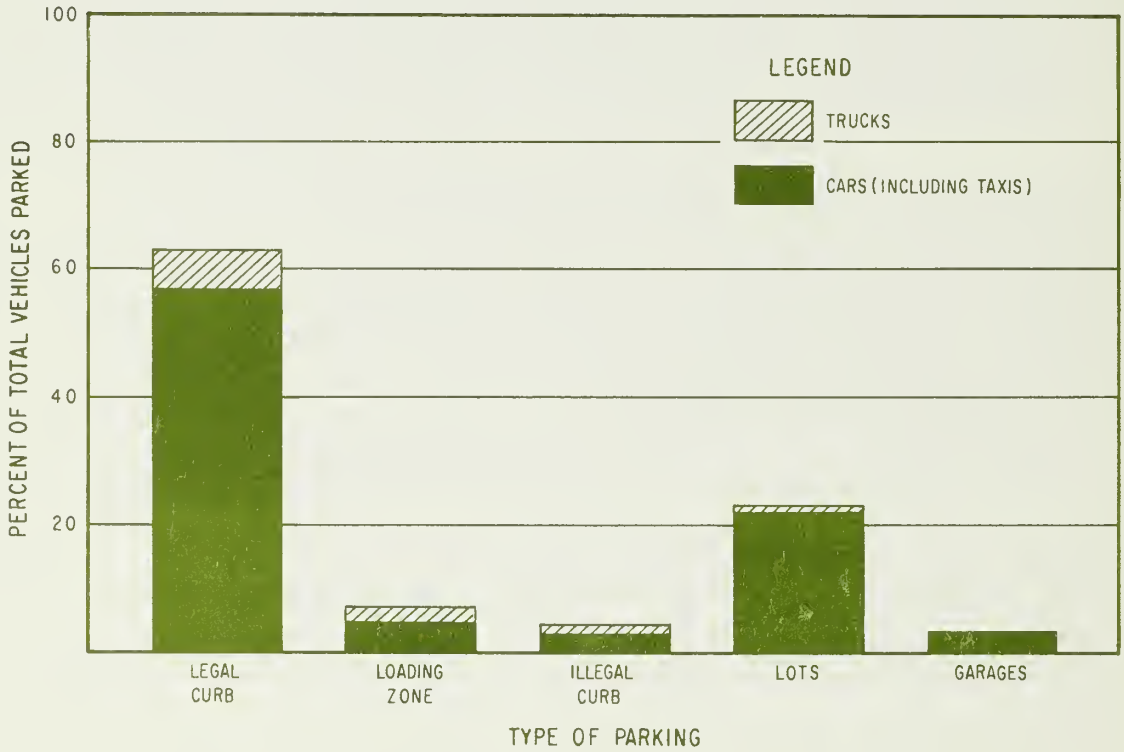
NOTES: SPACES STUDIED = 1598 CURB + 829 OFF STREET = 2427. STUDIES MADE WED. 9-27-61 & SAT. 8-19-61

COMPARISON OF WEEKDAY AND SATURDAY PARKING ACCUMULATION AT REPRESENTATIVE CURB AND OFF-STREET SPACES

USAGE OF PARKING SPACES

A total of 17,743 vehicles parked in the survey area between 9:00 A.M. and 6:00 P.M. on a weekday. Of these, 1,775, or 10.0 percent, were trucks and 194, or 1.1 percent, were taxis. The remainder were passenger cars.

FIGURE 26



PERCENT OF VEHICLES OF EACH TYPE PARKED IN THE FIVE MAJOR TYPES OF PARKING FACILITIES IN THE SURVEY AREA

Figure 26 shows a graphic summary of the type of parking space used by all vehicles parked in the survey area. The same data are presented in tabular form in Table 3 of the Parking Data Book. Curb spaces made up only 34 percent of the total supply in the central business district, but almost three quarters of all vehicles parked at the curb. Only 26.8 percent parked in lots or garages. Over one-half of all vehicles parked in the area used metered curb spaces with time limits of from 12 minutes to two hours.

Only 3.3 percent of all vehicles parked in the survey area during the study period were parked at illegal curb spaces. This number is exceptionally small when compared with similar studies made in other cities. Recent surveys in Helena and Great Falls, for example, indicated that illegal parkers amounted to 8.6 percent and 4.6 percent, respectively, of the total. In addition, overtime parking at metered spaces or those with posted time limits was not a serious problem. Excellent enforcement of curb parking regulations was observed throughout the study.

Table 7 of the Parking Data Book shows the number of spaces available, number of vehicles parked, and turnover of legal curb, lot and garage spaces at each block face in the survey area. Vehicles parked legally in loading zones or in special permit curb parking spaces were not included in computations of turnover since these were not considered available spaces. In addition, illegal parkers were excluded in the calculation of rate of turnover.

For the entire survey area, the average rate of turnover was 3.4 vehicles per space during the hours of the study. Average turnover at legal curb spaces was 7.0 vehicles per space; at lots, 1.6 vehicles; and in garages, 1.3 vehicles.

Maximum turnover in a parking lot was 15.3 times. Curb spaces with the greatest turnover were adjacent to the post office. This block had 38 curb parking spaces which were used by 1,056 parkers during the nine-hour study period for an average rate of turnover of 27.8 vehicles per space. Turnover at two curb faces on this block exceeded 40 vehicles per space.

Turnover at parking spaces in the core area was greater than in the survey area as a whole. Average curb turnover in the core area was 14.3 vehicles per space or twice that in the survey area. Turnover at core area parking lots was 2.2 times. The average for all spaces in the core area was 5.0 vehicles per space.

To facilitate comparison of the usage of parking spaces with supply or demand, the parking space-hour is used as a common denominator. Space-hours of supply are equal to the number of available parking spaces multiplied by the number of hours during the study when parking is permitted. Similarly, space-hours of usage are the number of

vehicles parked times the length of time parked and space-hours of demand are the number of destinations in any location multiplied by the length of time parked.

The supply of parking spaces defined in terms of space-hours is a theoretical value. Actually, the theoretical supply must be reduced because all spaces cannot be occupied 100 percent of the time. There is always a lapse between the departure of one vehicle from a parking space and the arrival of another. In addition, normal fluctuations in demand from hour to hour or from day to day must be anticipated. It is necessary, therefore, to determine the percentage of time during which spaces may be occupied under practical operating conditions in order to make a reasonable comparison of parking space supply, usage and demand. Examination of usage studies in prime locations indicated that the practical capacity of curb parking spaces approximated 90 percent of the actual. The practical capacity of off-street spaces available to the general public was estimated at 85 percent of actual. In accordance with recommended study procedures, the capacity of private lots and garages was not discounted.

The following table summarizes supply and usage of parking spaces in the survey and core areas between 9:00 A.M. and 6:00 P.M.

SUPPLY AND USAGE OF PARKING SPACE
IN THE SURVEY AND CORE AREAS

	Survey Area			Core Area		
	Space-Hours of Supply		Space-Hours Used*	Space-Hours of Supply		Space-Hours Used*
Type of Space	Actual	Practical		Actual	Practical	
Legal Curb	13,912.0	12,520.8	9,128.0	2,538.0	2,283.3	2,021.2
Lots	23,400.0	22,012.6	10,526.4	3,006.0	2,898.0	1,541.7
Garages	4,059.0	3,467.7	1,476.2	4,059.0	3,467.7	1,476.2
Total	41,371.0	38,001.1	21,130.6	9,603.0	8,649.0	5,039.1

*-Excludes vehicles parked in restricted curb parking areas.

The preceding table shows 21,130.6 space-hours used at legal spaces. In addition, there were 334.0 space-hours used at restricted curb spaces, but it would be inaccurate to include these in the total since space-hours of supply do not include restricted curb spaces. Average occupancy during the nine-hour survey period was 55.6 percent of practical capacity.

In the core area, there were 9,603.0 actual space-hours available during the study with practical supply equal to 8,649.0 space-hours. Usage amounted to 5,039.1 space-hours, or 58.2 percent of practical capacity.

Similar comparisons were also made of supply and usage during the peak hour. Peak-hour usage amounted to 62.0 percent of practical supply in the survey area and 66.8 percent in the core area.

PARKING HABITS

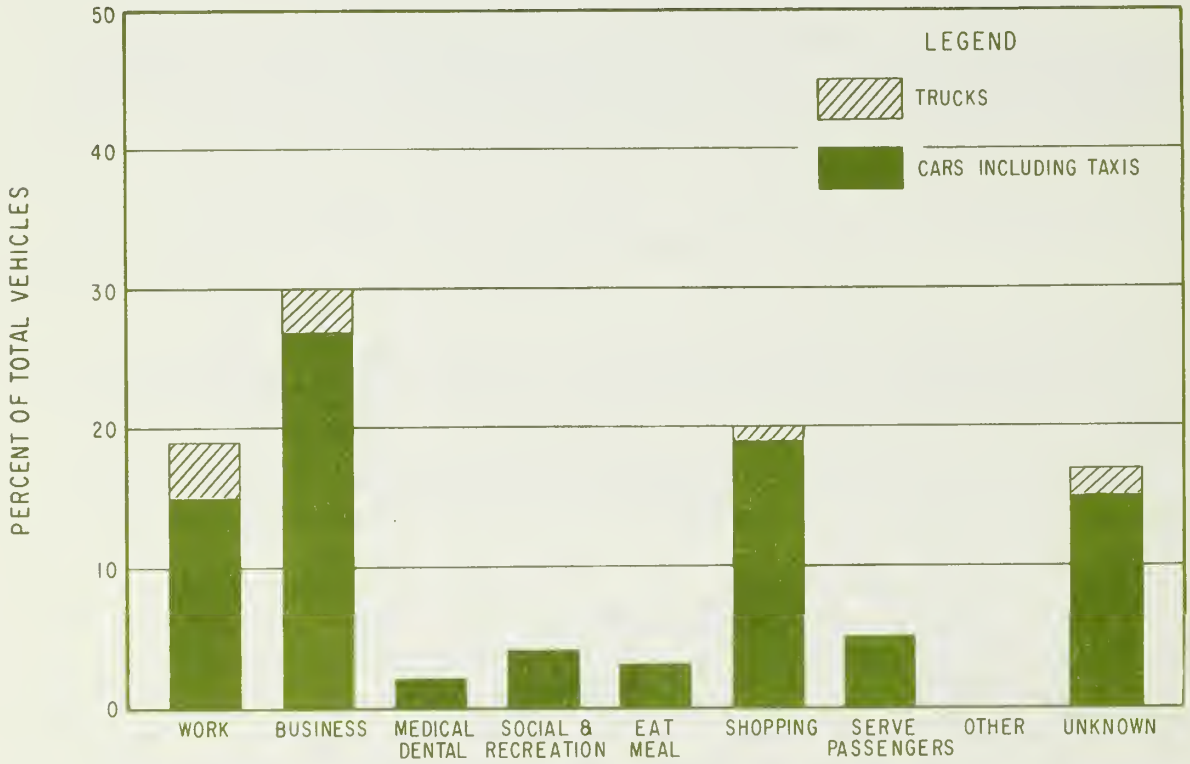
Parking habits of motorists who park in the central business district are an important consideration in formulating plans for future facilities. They must be correlated with other studies of existing and anticipated parking supply and demand to determine a program for provision of sufficient parking spaces to meet the future needs of the area.

Parking habits in the Billings central business district were determined by interviewing motorists at their parking space. A total of 14,840 drivers--or 83.6 percent of those parked in the area between 9:00 A.M. and 6:00 P.M.--were interviewed. They were asked to provide information with regard to trip purpose, downtown destination and origin of trip. Other data concerning length of time parked and type of space were recorded by the interviewer. Distance from parking space to destination was computed later in the office.

Purpose of trip is one of the most important considerations in determining parking requirements. Other habits of parkers such

as length of time parked, distance from parking space to destination and type of parking space used often can be directly related to trip purpose. Figure 27 shows the percent of drivers parked in the survey area for each trip purpose. If drivers with unknown purpose of trip are distributed in accordance with known trip purposes, motorists driving to work together with those on business and shopping trips would make up about 82 percent of all parkers in the central business district on an average weekday.

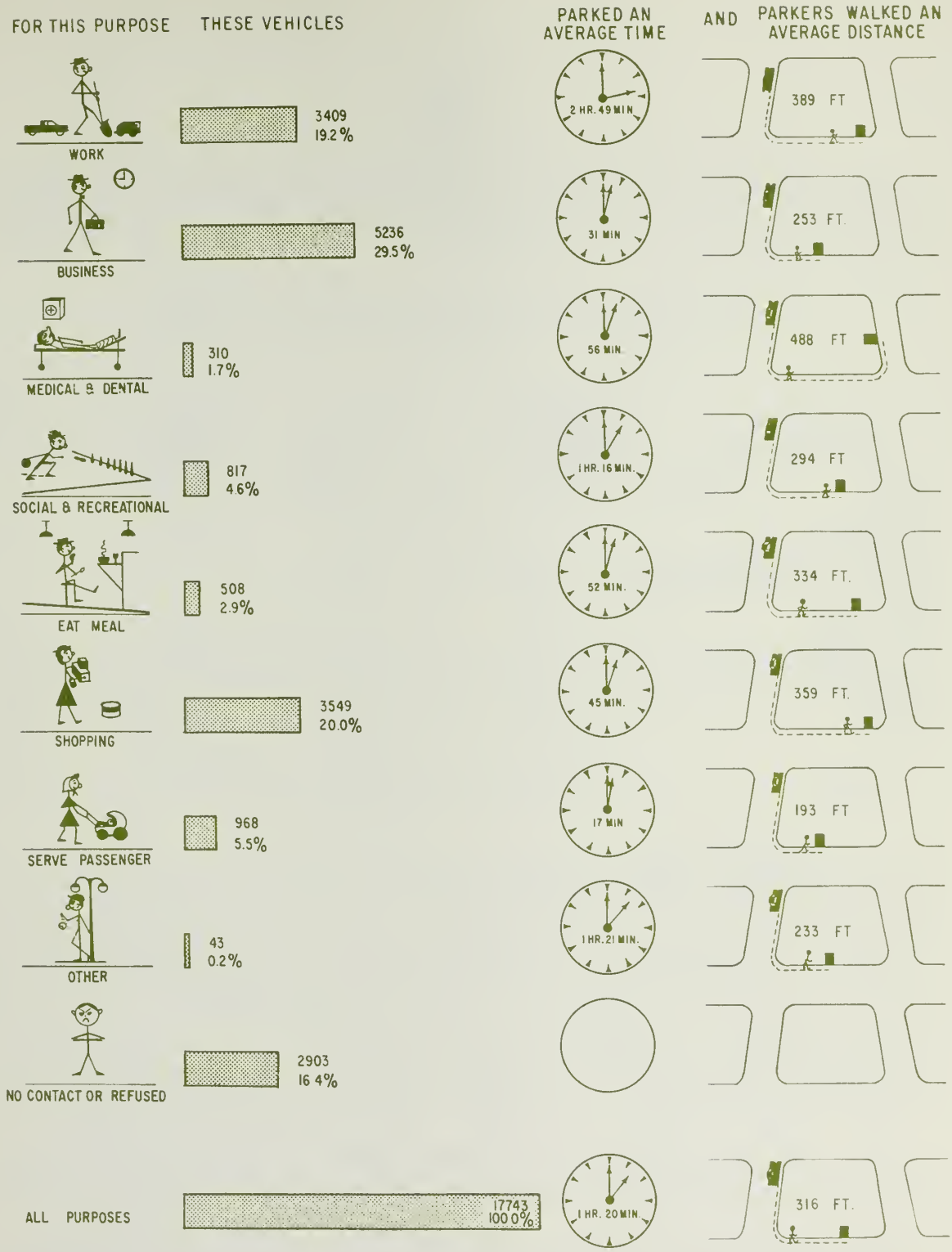
FIGURE 27



PERCENT OF TRUCKS AND AUTOS PARKED ACCORDING TO THE PURPOSE OF TRIP

Figure 28 presents a graphic summary of some of the most important parking habits for each trip purpose. It can be seen readily that there is a relationship between trip purpose and length of time parked and, correspondingly, distance walked from parking space to destination.

FIGURE 28



PARKING HABITS IN THE BILLINGS CENTRAL BUSINESS DISTRICT
WEEKDAY, 1961 - 9:00 A.M. - 6:00 P.M.

The significance of work trips made to the central business district is often understated. As shown in the following table, worker-parkers made up 19.2 percent of the total, but accounted for 40.5 percent of all parking space-hours used.

NUMBER OF PARKERS AND SPACE HOURS
USED FOR EACH TRIP PURPOSE

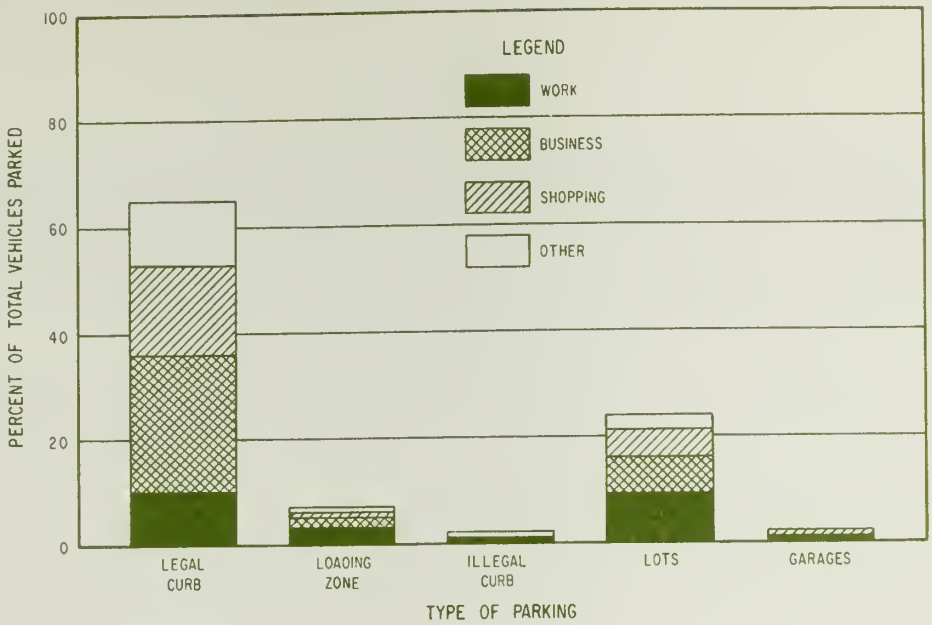
Trip Purpose	Total No. of Parkers	Percent of Total	Space-Hours Used	Percent of Total Space-Hours
Work	3,409	19.2	9,595.0	40.5
Business	5,236	29.5	2,718.9	11.5
Medical and Dental	310	1.7	291.1	1.2
Social and Recreation	817	4.6	1,036.8	4.4
Eat Meal	508	2.9	439.6	1.9
Shopping	3,549	20.0	2,688.0	11.4
Serve Passenger	968	5.5	268.1	1.1
Other	43	0.2	58.0	0.2
Unknown	2,903	16.4	6,576.3	27.8
Total	17,743	100.0	23,671.8	100.0

If unknown trips are distributed by purpose in a manner similar to the "knowns", worker-parking would account for over one-half of all space-hour usage in the survey area. Trips for other purposes--notably business and shopping--were greater in number but shorter in duration. The average length of stay of worker-parkers in Billings, moreover, was shorter than has been observed in other similar surveys.[1] It was our observation that this resulted primarily from a large number of workers going home for lunch. The work trip for these motorists was recorded as two trips of relatively short duration rather than one trip of longer stay.

Type of parking space used is also a function of trip purpose and, hence, length of time parked and distance from parking space to

[1]The average length of time parked for work in five cities with population between 50,000 and 100,000 persons was 3.8 hours. This compares with 2.8 hours in Billings. Source: "Parking Guide for Cities", U.S. Department of Commerce, Bureau of Public Roads, 1956, Table 20.

FIGURE 29



PERCENT OF VEHICLES PARKED ACCORDING TO TYPE OF PARKING FACILITY AND PURPOSE OF TRIP

destination. The following table summarizes the percent of total parkers for each major trip purpose using various types of spaces. The same data are shown graphically in Figure 29.

TYPE OF SPACE USED
RELATED TO PURPOSE OF TRIP

	Percent of Parkers for Each Trip Purpose Using Various Types of Space				
Type of Space	Work	Business	Shopping	Other	Total
Curb					
Metered	30.9	57.7	64.6	48.8	51.2
Unmetered (Legal)	11.3	14.7	5.4	13.8	11.9
Loading Zone	11.8	4.8	2.5	8.5	6.8
Illegal	5.4	2.8	1.4	3.7	3.3
Total Curb	59.4	80.0	73.9	74.8	73.2
Lots					
Available to Public	9.1	16.7	20.2	10.6	14.0
Private	27.7	1.7	0.3	11.7	9.6
Garages	3.8	1.6	5.6	2.9	3.2
Grand Total	100.0	100.0	100.0	100.0	100.0

The basic characteristic in parking habits brought out by the preceding table is the predominant use of private parking lots by worker-parkers. Well over one-half of all motorists on business and shopping trips used metered curb spaces, but many worker-parkers staying for longer periods were forced to find space elsewhere.

Accumulation of vehicles parked in the survey area also indicated great variations according to trip purpose as shown in the following table.

PEAK ACCUMULATION OF VEHICLES PARKED
IN THE SURVEY AREA FOR EACH TRIP PURPOSE

Trip Purpose	Total No. of Parkers	Peak Accumulation		Percent of Total Vehicles Parked at Peak
		No. of Vehicles	Time	
Work	3,409	1,060	10:00-11:00 A.M.	31.1
Business	5,236	371	2:00- 2:30 P.M.	7.1
Medical and Dental	310	59	3:00- 3:30 P.M.	19.0
Social and Recreation	817	101	5:00- 5:30 P.M.	12.4
Eat Meal	508	123	12:00-12:30 P.M.	24.2
Shopping	3,549	399	2:00- 2:30 P.M.	11.2
Serve Passenger	968	57	4:30- 5:00 P.M.	5.9
Other	43	13	9:00- 9:30 A.M.	30.2
Unknown	2,903	752	1:30- 2:00 P.M.	25.9
All Purposes	17,743	2,736	2:00- 2:30 P.M.	15.4

Of the major categories of trip purpose, business trips were most dispersed throughout the day. At periods of peak accumulation, there were almost three times as many workers parked as there were motorists on business trips--even though the number of business parkers for the total survey period was over 50 percent greater.

Origin of trip was defined as the last place at which the vehicle was parked prior to the space in the central business district at which

the driver was interviewed. The following table summarizes the number and percentage of drivers by sector of origin:

ORIGINS OF DRIVERS PARKED IN THE SURVEY AREA

Sector of Origin*				
Number	General Location	No. of Drivers	Percent of Total	Percent of "Knowns"
Internal Survey Area				
0	Central Business District	2,393	13.5	18.1
1	North of Grand, West of 32nd	2,139	12.0	16.2
2	Between Grand and Railroad West of 32nd	3,058	17.2	23.1
3	South of Railroad, West of Riverside Drive	631	3.6	4.8
4	South of Railroad, East of Riverside Drive	659	3.7	5.0
5	North of Railroad, East of 32nd	2,264	12.8	17.1
Outside of Internal Area				
6	Remainder of Yellowstone County	1,168	6.6	8.8
7	Eastern Montana	460	2.6	3.5
8	Western Montana	237	1.3	1.8
9	Remainder of U.S. and Canada	216	1.2	1.6
	Unknown	4,518	25.5	-
	Total	17,743	100.0	100.0

*-Sector boundaries shown in Exhibits 1 through 5 of the Traffic Data Report.

Destinations of trips for various major purposes are shown in Exhibit 38. Work trips were more evenly distributed throughout the area than trips for other purposes. Approximately 43 percent of all worker-parkers had destinations in the core area compared with 51 percent of those making business or shopping trips.

The following table summarizes correlations between length of time parked and distance from parking space to destination.

LENGTH OF TIME PARKED RELATED TO DISTANCE FROM PARKING SPACE TO DESTINATION

Length of Time Parked	Number of Vehicles	Percent of Total	Average Distance Walked (Feet)
11 Minutes or Less	5,390	30.4	173
12 - 29 Minutes	4,175	23.5	268
30 - 59 Minutes	2,792	15.7	371
One - Two Hours	2,030	11.4	432
Two - Three Hours	918	5.2	439
Three - Four Hours	559	3.2	505
Four - Five Hours	506	2.9	546
Five - Six Hours	212	1.2	592
Six - Seven Hours	147	0.8	512
Seven - Eight Hours	168	0.9	660
Eight - Nine Hours	232	1.3	696
Nine Hours or Over	614	3.5	642
Total	17,743	100.0	
Average			316

As expected, motorists staying for the shortest time parked closest to their destinations. Average walking distance of 316 feet indicates that parking spaces in downtown Billings will meet with general public acceptance at distances of up to one block (approximately 350 feet) from the parker's destination.

THE DEMAND FOR PARKING SPACE

Previous sections of the report have been concerned primarily with usage of parking spaces as well as habits of persons parked in the central business district of Billings. Demand is distinguished from usage in that it is an indication of where motorists wish to park rather than where they are parked under existing conditions. It might be looked upon as the theoretical situation which would result if all motorists were provided parking spaces immediately adjacent to their destinations. Such a solution is often impractical, of course, and it will be the object of the remainder of this report to analyze present and future demand in light of acceptable criteria developed from studies of parking habits. Parking supply, demand and usage in the survey area is shown in Exhibit 39. A detailed summary of these data by block face is presented in Table 16 of the Parking Data Book. Total parking demand in the survey area amounted to 20,702.7 space-hours. Usage was 427.9 space-hours greater due to 264 motorists parked in the area, but with destinations outside of the area. (The survey procedures did not permit determination of the corresponding number of motorists parked outside of the survey area and having destinations in the area.)

Parking demand in the core area exceeded usage. In the nine-block core area, demand was 9,433 space-hours during the survey period compared with usage of 5,039 space-hours. The following table presents a block-by-block summary of demand and usage in the core area.

PARKING USAGE AND DEMAND IN THE CORE AREA

	Usage		Demand	
Block Number	Number of Vehicles Parked	Space-Hours Used	Number of Destinations	Space-Hours of Demand
051	701	920	1,119	1,878
052	444	336	1,258	1,725
053	756	748	741	864
054	464	376	624	694
055	561	651	592	839
056	534	350	429	426
081	455	269	752	875
082	569	986	773	1,303
083	1,136	403	1,389	829
Total Core Area	5,620	5,039	7,677	9,433

Demand also exceeded usage in 12 other blocks of the survey area as shown in Exhibit 39.

Additional analyses were made of demand for parking space at the peak hour (1:30-2:30 P.M.). The following table shows a comparison of peak-hour to all-day demand for each of the nine blocks in the core area:

TOTAL AND PEAK-HOUR DEMAND BY BLOCK
IN THE CORE AREA

Block Number	Number of Destinations		Percent Peak-Hour of All Day
	All-Day*	Peak-Hour	
051	1,119	382	34.1
052	1,258	343	27.3
053	741	172	23.2
054	624	141	22.6
055	592	154	26.0
056	429	89	20.7
081	752	177	23.5
082	773	215	27.8
083	1,389	227	16.3
Total Core Area	7,677	1,900	24.7

*-9:00 A.M.-6:00 P.M.

Approximately one-quarter of all parkers destined for the core area were parked during the peak hour. In terms of space-hours, peak hour demand in the core area amounted to 1,206 space-hours, or 12.8 percent of the all-day total.

PARKING SPACE NEEDS--SUPPLY VS. DEMAND

Consideration has been given in previous sections of the report to parking supply, usage and demand in the central business district of Billings.

Theoretical supply of parking space has been determined to be 41,371 space-hours during the period from 9:00 A.M. to 6:00 P.M. This has been reduced to practical capacity of 38,001 space-hours, however, since 100 percent usage of available parking spaces is not possible in actual practice. Total demand in the survey area was 20,703 space-hours leaving a surplus of practical supply over demand amounting to 17,298 space-hours.

Supply and demand for parking space in each block of the survey area is shown in Exhibit 39. Demand exceeded supply in nine blocks. A summary of parking deficiency in these blocks, expressed both in terms of space-hours and parking spaces, is shown below.

1961 PARKING DEFICIENCY IN THE SURVEY AREA
INDICATED BY COMPARISON OF
SUPPLY AND DEMAND IN EACH BLOCK

Block	1961 Parking Deficiency	
	Space-Hours	Spaces
025	267.9	35
045	92.5	12
046	337.2	44
052	1,201.6	157
054	262.1	34
055	48.0	6
074	28.8	4
081	524.5	69
083	26.0	3
Total--9 Blocks	2,788.6	364

The availability of a parking space, however, is a function of its distance from the parker's destination. Every motorist would prefer to park at the door of the building to which he is destined. Under normal circumstances, of course, this is neither possible nor practical, and the average driver is willing to accept a reasonable walking distance between his parking space and destination. It has also been shown previously that, for various reasons, the distance walked is closely related to purpose of trip and length of time parked.

The following table shows average walking distance related to purpose of trip in the Billings central business district.

AVERAGE WALKING DISTANCE
RELATED TO PURPOSE OF TRIP

Trip Purpose	No. of Vehicles Parked	Percent of Total Parkers	Average Distance Walked (Feet)
Work	3,409	19.2	389
Business	5,236	29.5	253
Medical and Dental	310	1.7	488
Social and Recreational	817	4.6	294
Eat Meal	508	2.9	334
Shopping	3,549	20.0	359
Serve Passenger	968	5.5	193
Other	43	0.2	233
No Contact or Refused	2,903	16.4	-
Total	17,743	100.0	
Average Distance Walked			316

It appears from the table that the average motorist in downtown Billings is willing to accept parking at a distance of about one block from his destination. Supply and demand of parking space at each block face in the central business district were further analyzed, therefore, to determine the resultant deficiency when spaces within 350 feet of the driver's destination were considered available. The table on the following page summarizes 1961 parking deficiency based on an acceptable walking distance of 350 feet.

1961 PARKING DEFICIENCY BASED ON
DEMAND THROUGHOUT THE STUDY PERIOD
AND ACCEPTABLE WALKING DISTANCE OF 350 FEET

Block	1961 Parking Deficiency	
	Space-Hours	Spaces
046	130.4	17
052	278.0	36
054	106.6	14
055	91.7	12
081	159.5	21
Total	766.2	100

Estimated 1961 parking deficiency of 100 spaces is based on supply and demand for spaces during a nine-hour period on an average weekday. In practice, however, parking supply must be related to periods of peak demand. Peak-hour parking supply, usage and demand on a normal weekday have been summarized in Tables 17 and 17-A of the Parking Data Book. The peak hour of parking occurred between 1:30 P.M. and 2:30 P.M. The following table shows the net resulting deficiency based on provision of an adequate number of parking spaces within 350 feet of each driver's destination at the peak hour.

1961 PARKING DEFICIENCY BASED ON
PEAK-HOUR DEMAND AND ACCEPTABLE
WALKING DISTANCE OF 350 FEET

Block	1961 Peak-Hour Parking Deficiency	
	Space-Hours	Spaces
046	19.1	22
052	108.3	127
054	45.1	53
055	28.8	34
081	3.5	4
Total	204.8	240

Exhibit 40 shows the location of blocks at which there was a peak-hour parking deficiency in 1961, as well as the area within 350 feet of each deficient block.

It is concluded, therefore, that 240 additional parking spaces are required in the Billings central business district to provide a space within 350 feet of his destination for each motorist destined to the area at the peak hour. Provision of about 100 additional spaces would meet average demand throughout the day, but would require an average walking distance in excess of 350 feet for some motorists parked at the peak.

ESTIMATES OF FUTURE PARKING DEMAND

Since the comprehensive parking study in the Billings central business district was made in conjunction with an area-wide origin-destination study, an unusual opportunity was afforded to project future parking requirements. It has been mentioned previously that minor modifications were made in the parking survey procedures to allow use of traffic expansion data in the parking survey.

The origin-destination study indicated 19,775 auto-driver trips with destinations in the central business district during a 24-hour period on a weekday. (See Table F-2 of the Traffic Data Report.) A total of 17,743 central business district parkers were recorded in the parking survey for the nine-hour study period, indicating a reasonable comparison of similar data in the two surveys.

Expansion factors were developed for each zone by purpose of trip. Purpose categories included "work", "business", "shopping", and "other". It should be noted, however, that central business district zones used in the origin-destination survey each included from four to six zones (or blocks) in the parking survey. References hereinafter to zone numbers, therefore, apply to the second digit of the block number--i.e. zone 01 includes blocks 011, 012, 013, 014, 015 and 016, etc.

Expansion factors for trips to central business district zones were developed previously in the origin-destination survey. See Table 12. The estimated total number of parkers in each zone in 1981 was determined by applying the zonal expansion factor to the number of drivers parked in the zone in 1961. In forecasting 1981 parking usage by purpose

of trip, it was assumed that trips for all purposes except work, business and shopping would increase in the same proportion as the total number of trips to each zone. Shopping trips were expanded by 40 percent in accordance with factors shown in Table 12 for trips to "services, storage and commercial" land use. Work and business trips were then expanded by a factor which produced the desired future total of trips to each zone. The following table shows expansion factors used for each zone by purpose of trip:

CENTRAL BUSINESS DISTRICT EXPANSION
FACTORS FOR EACH ZONE BY PURPOSE OF TRIP

Zone	Expansion Factor to 1981 by Purpose of Trip				
	Work	Business	Shopping	Other	Total
01	1.58	1.58	1.40	1.49	1.49
02	1.82	1.82	1.40	1.77	1.77
03	1.23	1.23	1.40	1.29	1.29
04	1.60	1.60	1.40	1.52	1.52
05	1.48	1.48	1.40	1.45	1.45
06	1.22	1.22	1.40	1.28	1.28
07	1.40	1.40	1.40	1.40	1.40
08	1.58	1.58	1.40	1.55	1.55
09	1.43	1.44	1.40	1.43	1.43

These expansion factors were applied to the present number of motorists destined to each zone of the central business district in order to calculate estimated parking demand in 1981. A total of 1,237 drivers who parked legally in loading zone or special permit spaces were not included since these parking spaces were not considered in determining available supply. In addition, 264 central business district parkers with destinations outside of the area were excluded, leaving 16,242 vehicles as the base for expansion.

Expansion of parking demand to 1981 was determined by purpose of trip. It was necessary, therefore, to adjust the data for motorists who were not contacted in the survey or refused to cooperate. A total of 2,627 trips in this category were distributed in proportion to the known purposes of other parkers in each zone.

The table on the following page shows 1961 destinations by purpose of trip in each zone as well as the estimated number in 1981.

DESTINATIONS IN EACH ZONE BY PURPOSE OF TRIP
1961 AND ESTIMATED 1981

Zone	1961 Destinations by Purpose of Trip*					1981 Destinations by Purpose of Trip				
	Work	Business	Shopping	Other	Total	Work	Business	Shopping	Other	Total
01	212	243	451	143	1,049	335	384	631	213	1,563
02	419	1,073	217	304	2,013	766	1,956	303	538	3,563
03	130	107	125	42	404	159	132	176	54	521
04	409	453	573	292	1,727	654	724	803	444	2,625
05	996	1,410	1,662	695	4,763	1,471	2,093	2,334	1,008	6,906
06	226	296	281	163	966	276	359	392	209	1,236
07	283	252	192	174	901	396	353	269	243	1,261
08	540	1,602	502	515	3,159	852	2,541	705	798	4,896
09	306	387	118	449	1,260	438	557	166	641	1,802
Total	3,521	5,823	4,121	2,777	16,242	5,347	9,099	5,779	4,148	24,373
Percentage	21.7	35.8	25.4	17.1	100.0	21.9	37.4	23.7	17.0	100.0

*-"No Contact and Refused" trips distributed in proportion to knowns.

Note: Expansion factors were developed in the origin-destination traffic study. The "total" expansion factor for each zone is the average factor for each purpose weighted by the number of trips for each purpose recorded in the origin-destination survey. Since the proportional breakdown of trips, by purpose, in the parking survey did not correspond exactly with that in the origin-destination survey, adjustment was necessary. The "total" expansion factor was used as the control and adjustments were made by purpose to arrive at the desired total.

It is estimated that the total number of motorists parking at available spaces in the central business district between 9:00 A.M. and 6:00 P.M. will increase from 16,242 in 1961 to 24,373 in 1981--or by about 50 percent. Business trips, it is anticipated, will increase by a larger percentage than those for other purposes, while the increase in shopping trips will be less than the average for all other purposes. The latter reflects anticipated additional expansion of retail stores in outlying shopping centers. Trips for work and "other" purposes are expected to increase in about the same proportion as the total.

Estimated parking space-hours of demand in 1981 were computed by applying 1961 parking characteristics to the estimated future number of trips for each purpose. The average number of parking space-hours per trip was computed by purpose for each zone. This factor was then multiplied by the estimated number of destinations in 1981 to determine space-hours of demand. It is not expected that parking characteristics by purpose of trip will change significantly. Parking space-hours used by motorists who were not contacted or refused to cooperate in the survey were also distributed by trip purpose in the same proportion as the "knowns".

The following table summarizes estimated 1981 parking demand in each zone for the period from 9:00 A.M. to 6:00 P.M. Similar data derived from the 1961 survey is also shown for comparison.

ESTIMATED 1981 PARKING DEMAND BY TRIP PURPOSE
AND COMPARISONS WITH 1961 DEMAND AND SUPPLY

Zone	Estimated Space-Hours of Demand--1981					Total Space-Hours of Demand 1961	1961 Practical Capacity (Space-Hours)	Space-Hours of Surplus or (Deficiency)	
	Work	Business	Shopping	Other	Total			1961	1981
01	963.6	211.5	328.2	158.6	1,661.9	1,484.0	5,943.6	4,459.6	4,281.7
02	2,881.7	1,118.8	186.7	449.8	4,637.0	2,606.5	5,871.7	3,265.2	1,234.7
03	786.4	178.2	107.7	85.6	1,157.9	923.7	4,351.6	3,427.9	3,193.7
04	1,746.5	441.9	604.0	314.6	3,107.0	2,014.0	3,486.2	1,472.2	379.2
05	4,757.2	1,230.7	2,524.2	783.2	9,295.3	6,427.6	5,802.3	(625.3)	(3,493.0)
06	988.6	249.9	280.8	361.8	1,881.1	1,497.1	4,265.1	2,768.0	2,384.0
07	1,066.4	253.8	115.2	226.7	1,662.1	1,193.3	2,350.4	1,157.1	688.3
08	2,606.2	1,139.6	575.7	605.7	4,927.2	3,158.0	3,120.3	(37.7)	(1,806.9)
09	1,170.0	287.8	98.3	428.0	1,984.1	1,398.5	2,809.9	1,411.4	825.8
Total	16,966.6	5,112.2	4,820.8	3,414.0	30,313.6	20,702.7	38,001.1	17,298.4	7,687.5

The indicated parking surplus of 17,298.4 space-hours in 1961 is expected to decrease to about 7,700 space-hours in 1981--or by more than 50 percent. It has been shown previously, however, that many surplus spaces in fringe areas are too far removed from the core to be useful in compensating for concentrated areas of deficiency.

In our opinion, there are sufficient existing parking spaces in zones 01, 02, 03, 06 and 09 to meet anticipated future demand. Increased parking demand in zones 04, 05, 07 and 08, however, will have to be met, for the most part, through provision of additional off-street parking facilities. It has been estimated that approximately 690 additional parking spaces will be required by 1981 in or near zones 05 and 08--which comprise the core of the business district. This number includes 83 spaces required to meet 1961 deficiency as well as an estimated 607 additional spaces required by 1981. It was assumed that one-half of increased parking demand in zones 04 and 07 will have to be provided for in new facilities. The remainder of increased parking demand can be balanced by surplus capacity in these zones or in nearby blocks in other zones. Approximately 80 additional spaces will be required in or near zone 04 and 30 spaces in or near zone 07--bringing the total requirement in the central business district to 800 spaces.

Deficiencies in zones 04 and 07 will accrue, we believe, in blocks 046 and 073 (see Exhibit 34) which are too far removed from the fringe areas of these zones to benefit from residual surpluses. In terms of peak-hour parking demand, there is an existing deficiency of 19.1 space-hours in zone 046 and a surplus of 1.3 space-hours in zone 073.

A similar analysis was made of 1981 parking requirements based on peak-hour demand. In this respect, it was assumed that the percentage of total vehicles in each zone parked at the peak-hour would be approximately the same in 1981 as in 1961.

The following table shows a comparison of estimated 1981 peak-hour parking demand in each zone compared with peak-hour demand in 1961.

PEAK-HOUR PARKING SUPPLY AND DEMAND
1961 AND 1981

Zone	1961 Peak-Hour Practical Supply (Space-Hours)	Peak-Hour Demand (Space-Hours) 1961	Peak-Hour Demand (Space-Hours) Est. 1981	Surplus or (Deficiency) 1961	Surplus or (Deficiency) 1981
01	681.3	181.6	203.4	499.7	477.9
02	652.3	355.8	633.0	296.5	19.3
03	486.1	107.1	134.2	379.0	351.9
04	400.0	251.7	388.4	148.3	11.6
05	646.5	846.6	1,224.2	(200.1)	(577.7)
06	473.9	173.3	296.5	300.6	177.4
07	261.2	136.2	235.0	125.0	26.2
08	346.7	379.4	591.8	(32.7)	(245.1)
09	312.2	160.1	227.2	152.1	85.0
Total	4,260.2	2,591.8	3,933.7	1,668.4	326.5

In Zones 05 and 08, which were deficient with respect to parking spaces in 1961, parking demand is expected to increase by 590 space-hours. It has been estimated that approximately 900 additional parking spaces--650 in or near zone 05 and 250 in or near zone 08--will be required in the core area to meet present deficiencies as well as those anticipated through 1981. In addition, it has been estimated that about 300 additional spaces will be required in other zones (100 in or near

zones 04 and 02; 60 in or near zone 07; and 40 in or near zone 06[1]) to meet existing and anticipated 1981 peak-hour deficiencies.

In conclusion, it is our opinion that approximately 800 additional parking spaces will be required in the central business district by 1981 in order to meet normal parking requirements on an average day. Approximately 1,200 spaces will be required in order to provide convenient parking for all motorists parked in the area at the peak-hour. These additional requirements amount to an increase of from 17 to 26 percent over present parking supply of 4,639 spaces.

RECOMMENDATIONS

The central business district of Billings is fortunate in having an almost adequate supply of parking space at the present time. The problem at hand is one of assuring that sufficient spaces are provided in the future to meet additional parking demand.

It has been estimated that 1,200 additional parking spaces will be required in the central business district by 1981 in order to provide convenient parking for all motorists parked in the area at the peak-hour on a normal week day. Selection of specific sites for new off-street parking facilities would not be appropriate at this time, however, insofar as the availability of individual parcels of land may be expected to change from year to year. In addition, selection of specific sites to be acquired ten years or more in the future might unfairly affect property owners in their efforts to sell or lease the property prior to development. Recommended locations of new parking facilities have been shown, therefore, only with respect to the block in which we believe the facility should be located. See Exhibit 41. The recommended parking facility presumably would occupy one-quarter or less of the entire block. Priorities have also been assigned each general location to assist in stage development.

[1]It was assumed that one-half of increased parking demand in zones 04 and 07 will have to be provided for in new facilities. Since existing surpluses in zones 02 and 06 are more evenly spread throughout the zones, it was assumed that only 30 percent of increased parking demand in these zones will have to be provided in new facilities. Existing parking facilities in zones 01, 03 and 09, it has been estimated, will be adequate to meet anticipated future demand.

First priority has been assigned to a recommended parking facility in the block bounded by North 27th and 28th Streets, First Avenue North, and Second Avenue North (Block Number 055). The area of influence of a parking facility in this location would include several blocks which are currently deficient in parking space as well as many of the largest hotels and office buildings in the downtown area. It should be noted that influence areas shown in Exhibit 41 include the area within 350 feet of each block face. The actual area of influence of a parking facility in this location would be smaller--depending on the specific site selected as well as locations of entrances and exits--but would fall within the area shown.

Second priority has been assigned to a suggested site in Block Number 046, bounded by North 29th and 30th Streets, First Avenue North and Second Avenue North. Additional parking spaces in this location would augment supply near the main downtown retail center.

The third priority location would be in the block bounded by North 27th and 28th Streets, Third Avenue North and Fourth Avenue North (Block Number 025). This would be on the north fringe of the core area and could serve the growing complex of civic buildings in this area as well as core area uses.

Fourth priority has been assigned to a recommended location in Block Number 081, bounded by North 28th and 29th Streets, First Avenue North and Montana Avenue. A parking facility in this block would further augment supply in the core area.

It should be stressed that the locations shown are general in nature and are not intended as a rigid guide for future development. Should an equally suitable site in another nearby location become available for some unforeseen reason (i.e. fire, abandonment, etc.), the program should be modified accordingly.

The City presently operates a number of metered parking lots--primarily on leased land. The City has not gone to the extent, however, of issuing bonds or otherwise financing extensive parking improvements. It was our impression, furthermore, that there is strong public sentiment against municipal financing of parking improvements if provision of spaces by private enterprise can fill the same need.

Provision of off-street parking facilities by private investors is the oldest and still the most general method of financing. The National Parking Association cites figures from the U.S. Chamber of Commerce showing that 94 percent of all off-street parking facilities in the United States today were paid for by the four and three-quarter billion dollars invested by private enterprise. The remaining six percent of such facilities were municipally financed. Two modern parking garages with a combined capacity of 438 spaces have been constructed in the Billings central business district by private enterprise since 1957. There is no reason to doubt that additional similar facilities will be provided, as required, in the future.

Garage Types and Criteria

Estimates of parking demand in the Billings central business district indicate that additional centrally-located parking facilities will be required in the future. These will presumably be multi-level structures due to the high cost of land in the core area.

There are essentially three types of parking structures:

a. Ramp-type garages
b. Mechanical or elevator garages
c. Underground garages

In our opinion, ramp-type garages will best serve the purpose of providing additional off-street spaces in the Billings central business district. Mechanical parking facilities cost considerably more to build than ramp-type garages and are usually justified only on small sites in densely developed areas where land values are exceptionally high. Underground garages are also expensive to construct and are more costly to operate than a comparable facility above ground.

Innovations are being made constantly in garage design. Most floor plans, however, are either combinations or modifications of three basic ramp systems--the split-level, sloping-floor, or straight-ramp. In a split-level design, one portion of the building is raised less than a full level above the other. Two ramp movements are required, therefore, to ascend or descend one full level. A sloping-floor design makes use of gentle gradients on the parking floors for upward and/or downward

travel. These are often built in combination with a circular express ramp to provide a one-way traffic pattern. If the site is large enough, however, sloping floors can be used for both upward and downward circulation while still retaining a one-way traffic pattern. A straight-ramp design usually involves flat parking floors connected by ramps. The ramps are longer than required in a split-level design since they must be the height of a full parking level.

The following table sets forth suggested criteria for self-parking garage design based on present car sizes and operating characteristics:

SUGGESTED CRITERIA FOR PARKING GARAGES

		Acceptable	Desirable
A.	Car Spaces		
	Length	18'-0"	19'-0"
	Width	8'-6"	9'-0"
B.	Aisle Width		
	90° Parking	24'-0"	26'-0"
	60° Parking	18'-0"	20'-0"
	45° Parking	13'-0"	15'-0"
C.	Ceiling Height (clear)	6'-8"	7'-6"
D.	Ramp Gradient	10%	6%
E.	Clear Outside Turning Path (Radius)	25'-0"	28'-0"
F.	Lighting		
	Aisles	10 ft.-can.	15 ft.-can.
	Parking Area	3 ft.-can.	5 ft.-can.
G.	Number of Entrances and Exits	1 ea. per 350 spaces	1 ea. per 250 spaces

Modern construction methods allow the erection of "clear span" garages under most conditions. These are buildings without columns in the parking area. They not only provide a more efficient and flexible parking arrangement, but remove the physical and psychological hazard of parking between columns.

Economic Consideration

At current price levels, the construction of ramp-type parking garages can be expected to cost from $5.00 to $6.00 per square-foot or from $1,800 to $2,200 per car space. The actual cost will depend on such items as the size and shape of the available site; subsurface conditions; the number of levels constructed; and various structural and architectural features of the building.

In the typical four- or five-level ramp-type garage, about 70 square feet of ground area is required for each car space. Assuming acquisition of prime sites for parking might cost from $20.00 to $30.00 per square-foot, land cost would amount to from $1,400 to $2,100 per car space. The total cost per car space including construction, therefore, would be from $3,200 to $4,300.

Operating expenses vary considerably depending on the size of the facility and type of operation. The following table summarizes the range of recent operating expenses per car space at nine ramp-type garages in Chicago and Cincinnati.

Item	Annual Expense Per Car Space	
	Minimum	Maximum
Labor Expense		
Wages	$51.00	$171.00
Overhead	4.00	12.00
Total Labor Expense	$55.00	$183.00
Insurance	5.50	17.00
Utilities	5.00	26.00
Maintenance and Repairs	2.50	13.00
Supplies and Miscellaneous	2.00	16.00
Total Annual Operating Expense	$70.00	$255.00

Assuming straight-line amortization on an investment of $3,600 per car space at 5.0 percent interest over 25 years ($255.00 per year) and operating expenses at $100.00 per car space per year, annual parking revenue must amount to $355.00 per car space before a profit is realized. The economics of the situation are such, therefore, that garage construction can be justified at only the most convenient parking locations.

Recommended Plan of Action

Potential sites for off-street parking facilities in or near the areas recommended in the report should be acquired as soon as they become available or when increased parking demand indicates the need for new centrally located facilities. The sites may be operated initially as parking lots and later developed either partially or to full height as multi-level structures. Stage construction would permit more efficient operation until increased parking demand dictates construction of a larger facility. Provision for further expansion, in this manner, has been incorporated into design of the recently constructed parking garage at North 28th Street and Montana Avenue.

Most of the existing metered parking lots are too far removed from the core area to be used extensively by short-term parkers. See Exhibit 36. Weighted average occupancy[1] of these facilities between 9:00 A.M. and 6:00 P.M. on a weekday was only 29.0 percent. New lots, if acquired, should be in or near the core area, preferably in the general locations recommended in the report. Potential developers would then have the benefit of the City's operating experience to assist in analyzing the feasibility of constructing parking garages in these locations.

The newly created downtown "Park and Shop" program is also a project worthy of continued support. It has been reported that "Park and Shop" membership has increased from 75 to 180 since the program's inception in November 1962. In view of the prospect of increased competition from outlying shopping centers offering free customer parking, it is important that downtown merchants and property owners take effective measures to reduce the cost of customer's parking.

[1]Average occupancy weighted by the number of spaces in each parking lot.

Chapter XII

ALTERNATIVE RAILROAD GRADE CROSSING ELIMINATION AND HIGHWAY PLANS

The main line of the Northern Pacific Railway follows the valley of the Yellowstone River through eastern Montana, and traverses the City of Billings on a diagonal from the northeast to the southwest.

Railroad tracks and yards divide the city into northerly and southerly portions, and all vehicular and pedestrian traffic between these areas must cross the busy transcontinental railroad tracks.

Construction of grade separations or, alternatively, relocation of the railroad, has been urged for many years. It has been contended that the railroad constitutes a barrier preventing expansion of the central business district into the area south of the tracks. There have also been complaints of frequent and prolonged traffic delays caused by railroad operations. Finally, the land now occupied by railroad facilities, according to some studies, might be used more advantageously for other purposes.

ALTERNATIVE RAILROAD PLANS

In January 1960, De Leuw, Cather & Company prepared a report on Railroad Grade Crossing Elimination for Billings. The following plans were studied:

Plan I — Relocation of the railroad to an alignment paralleling proposed Interstate 90.[1]

[1]A second possible alignment, following the location of the existing sugar factory lead along State Avenue and identified as Plan II, was given careful consideration, but was rejected.

Plan III	Full elevation of the railroad tracks.
Plan IV	Partial elevation of the railroad tracks.
Plan V	Full depression of the tracks in a trainway.
Plan VI	Partial depression of the tracks in a trainway.
Plan VII	Construction of individual underpasses at 27th and 29th Streets.
Plan VIII	Construction of individual vehicular overpasses at 27th and 29th Streets.
Plan IX	Construction of overpasses at 25th and 32nd Streets.

Plans I and IV were shown to have the most merit, and were recommended for further consideration. These alternatives have been discussed for the past three years.

Railroad Plan I

Plan I would permit the redevelopment of 43 acres of land adjacent to the central business district. (An Act of Congress might be required, however, before the Railway could dispose of some of this land since it is Charter right of way acquired through a Congressional Act of 1864.) Plan I would also simplify redevelopment of the area immediately south of the tracks. Although no new crossings could be constructed east of 27th Street, it would be possible to add crossings between 30th Street and Division Street. The proposed double-track main line, 5.66 miles in length, would be about 0.59 miles longer than the present route. The total estimated direct cost of construction for Plan I was approximately $6,000,000. Right of way costs were estimated at approximately $1,430,000.

In March 1962, the Northern Pacific Railway Company prepared a study plan and report covering possible relocations of railway facilities around the south side of Billings. This study has been used in connection with the urban transportation study. Revisions

to the proposed alignment of Interstate 90, made in the period between 1960 and 1962, were instrumental in the Northern Pacific's decision to select an alignment farther from the central business district and about 0.4 miles longer than the alignment recommended in the earlier report by De Leuw, Cather & Company. The construction cost for this longer route, as estimated by the Northern Pacific, would be approximately $8,650,000. In addition, the Railway anticipated an annual loss due to the revised location which, if capitalized at 5.0 percent, would amount to almost $2,000,000, it was estimated. No right of way estimates were made for this plan.

Railroad Plan IV

Plan IV, as presented in the 1960 De Leuw, Cather report, proposed partial elevation of the Northern Pacific main line tracks along the present alignment to pass over 27th, 28th and 29th Streets. Each street would be depressed between five and six feet to minimize the length and height, and hence the cost, of track elevation. Existing buildings fronting on Montana and Minnesota Avenues would screen train operations from view, except at street crossings. Estimates of construction cost for partial elevation varied between $2,600,000 and $2,900,000, depending on slopes and shoulder widths. These estimates assumed that trains could operate over a single track during certain stages of construction. We have since been informed by the Railway, however, that two tracks would have to be kept in operation at all times. Assuming two-track operation during all stages of construction and using current unit costs, the construction cost of Plan IV is estimated at $3,200,000 to $3,500,000.

Comparison of Alternative Plans

Relocation of the Railway (Plan I) would be more beneficial than partial elevation of the tracks in furthering development of downtwon Billings. This plan would be the least acceptable to the Railway, however, since it would increase train miles and, consequently, result in increased operating and maintenance expense. The partially elevated railway plan (Plan IV) would be the least expensive. The actual cost to the City of Billings for Plan IV would probably be considerably less than $1,000,000, since matching federal and state

funds could be used for a large portion of the improvements. Federal and state funds would be available in the same amount for either Plan I or Plan IV. The city's share for the more expensive Plan I, therefore, would probably be over $5,000,000. At a recent meeting attended by city officials, it was the consensus that the high cost of Plan I will prevent relocation of the Railway unless the work can be incorporated in an overall urban renewal project.

Recommendations presented in this report, therefore, are based primarily on the assumption that the Railway will remain in its present location with grade separations provided at 27th, 28th and 29th Streets through the completion of Plan IV or other similar plan. The recommended arterial street plan shown in Exhibit 16 has been designed, however, so as not to preclude future relocation of the Railway.

ALTERNATIVE HIGHWAY PLANS

Exhibit 42 shows the differences between the two alternative plans. The important features of the plan with the Railway in its present location are shown in gray with additional features for the alternative plan shown in black. Relocation of the Railway would permit additional crossings at 32nd, 34th and Division Streets. It has been proposed that 34th Street be one-way southbound from First Avenue North to State Avenue while 32nd Street would be one-way northbound from State Avenue to Grand Avenue. The extension of Division Street from Montana Avenue to South 37th Street would be a two-way street. Division Street between Grand and Montana Avenues would be one-way southbound in both plans.

Should the Railway be relocated, it would be necessary to extend the bridge at the east interchange of Interstate 90 as well as to construct two additional bridges to carry ramps over the Railway. Exhibit 22 shows the possible railway relocation in the vicinity of the east interchange.

It would also be necessary to take South 27th Street and the South 28th Street ramp over the relocated Railway in the vicinity of the South 27th Street Interchange. The west interchange on Interstate 90 is also being designed to provide for possible future relocation of the Railway.

The following table summarizes estimated additional costs which would result from relocation of the Railway as provided in the alternative plan:

Item	Estimated Construction Cost
32nd Street	$ 80,000
34th Street	80,000
Division Street	86,000
East Interchange Bridges	624,000
South 27th Street Interchange Bridges	190,000
Washington Street Bridge	92,000
Billings Boulevard Bridge	92,000
West Interchange Bridges	*
Total	$1,244,000

*-Bridges provided for in Interchange Plan

A detailed urban renewal study would be required to determine the extent and type of development which would be appropriate in the area south of the Railway tracks. Redevelopment of the area might generate substantial volumes of traffic. The proposed street system, however, is deemed adequate for any demand likely to materialize. In addition, extension of 32nd, 34th and Division Streets would divert traffic from the central area, resulting in reduced traffic volumes on 27th, 28th and 29th Streets at the present railroad crossings.

Estimated 1981 traffic was assigned to the street system under the alternative plan (Plan I) of relocating the Railway rather than raising it. The table on the following page compares estimated daily traffic volumes on major streets crossing the present Railway alignment under each of the plans. Exhibit 43 shows estimated 1981 average daily traffic volumes on the recommended system with railroad relocation.

Crossing Location	Estimated 1981 Average Daily Traffic: Plan I (Railway Relocation)	Estimated 1981 Average Daily Traffic: Plan IV (Partial Elevation of Railway)
27th Street (NB)	5,500	6,900
28th Street (Broadway) (SB)	5,600	9,100
29th Street	1,200	4,700
32nd Street (NB)	4,300	-
34th Street (SB)	900	-
Division - S. 37th Street	9,600	-
6th Street West	10,300	16,500
Montana Avenue at 7th Street West	12,100	12,300
	49,500	49,500

If the Railway were relocated (Plan I), an estimated 14,800 vehicles would be diverted to additional crossings at 32nd, 34th and Division Streets on an average annual weekday in 1981. These would result in lower estimated traffic volumes on the present crossings at 27th, 28th and 29th Streets and 6th Street West. The greatest percentage decrease would be at the 29th Street crossing since this is closest to the new street extensions.

The table above indicates that 32nd and 34th Streets would not constitute a true one-way pair since almost five times as much traffic is anticipated on 32nd Street (northbound) than on 34th Street (southbound). The traffic assignment indicated that most southbound motorists would cross the present track alignment on the Division Street extension, rather than 34th Street, since Division Street and North 32nd Street would still be a major one-way couplet north of Montana Avenue. Estimated 1981 weekday traffic distribution on Division Street would be 8,100 vehicles per day southbound and 1,500 vehicles per day northbound.

Capacity analyses indicated that there would be sufficient capacity on 32nd, 34th and Division Streets to handle the additional traffic that would be diverted to these streets under Plan I. Modifications would be required at some intersections on Montana Avenue, however, to provide for additional traffic movements.

CONCLUSION

It is difficult to choose between alternative railroad grade crossing elimination plans when one is more desirable and the other more easily financed. The decision will have to be made after careful deliberation by the City of Billings. But while Billings may be able to postpone making a decision on its grade crossing problems, it cannot delay solving its other traffic problems. Traffic will double in the next twenty years. It is imperative, therefore, that plans and construction of new street improvements be started at the earliest possible moment. The recommended street improvement plan is designed to provide the maximum amount of service at minimum cost. With appropriate modifications, it could work equally well under either of the alternative plans for eliminating grade crossings.

TABLES

TABLE 1

STREET AND TRAFFIC CHARACTERISTICS
ARTERIAL STREET SYSTEM

Street	Major Directions	Right of Way (Feet)	Pavement Width (Feet)	Effective Traffic Lanes (One Direction)	Daily Traffic Volume(1)
Billings Boulevard	North - South	80 - 100	22	1	800 - 900
Belknap Avenue	East - West	60	20	1	800
Broadwater Avenue	East - West	70 - 80	24 - 48	1 - 2	300 - 8,500
Calhoun Lane	North - South	60	26 - 28	1	1,900
Central Avenue	East - West	60	26 - 32	1	900 - 6,100
Colton Boulevard	East - West	60	20 - 46	1 - 2	800 - 2,300
Division Street	North - South	60 - 80	50 - 60	2 - 3	3,800
Garden Avenue	North - South	50 - 60	20 - 24	1	(2)
Grand Avenue	East - West	60 - 80	23 - 60	1 - 3	1,000 - 12,400
Grandview Boulevard	East - West	60	30	1	3,700
Jackson Street	North - South	60	22 - 35	1	900
King Avenue	East - West	60	19 - 25	1	200 - 1,600
Lewis Avenue	East - West	60	23 - 48	1 - 2	1,800
Locust Street	North - South	60	35 - 50	1 - 2	300
Montana Avenue	North - South	60 - 89	28 - 60	1 - 3	6,700 - 10,800
Orchard Lane	North - South	60	28	1	1,900
Parkhill Drive	East - West	60	33 - 46	1 - 2	1,000 - 2,500
Poly Drive	East - West	60	25 - 50	1 - 2	2,900 - 6,900
Rehberg Lane	North - South	60	18 - 35	1	600 - 1,000
Rimrock Road	East - West	60	21 - 48	1 - 2	800 - 2,900
Riverside Road	North - South	60	18	1	600
State Avenue	East - West	60	22 - 34	1	1,200 - 1,900
Sugar Avenue	North - South	60	26 - 28	1	500
Virginia Lane	North - South	60	25 - 40	1 - 2	(2)
Washington Street	North - South	60	18 - 22	1	400
Zimmerman Trail	North - South		24	1	700
Montana Highway 3	East - West		27 - 55	1 - 2	1,000

TABLE 1 (Continued)

STREET AND TRAFFIC CHARACTERISTICS
ARTERIAL STREET SYSTEM

Street	Major Directions	Right of Way (Feet)	Pavement Width (Feet)	Effective Traffic Lanes (One Direction)	Daily Traffic Volume(1)
1st Avenue North	East - West	70 - 80	40 - 60	2 - 3	8,000 - 12,500
2nd Avenue North	East - West	80	50	2	3,900 - 6,500
3rd Avenue North	East - West	80	50	2	3,700 - 5,300
4th Avenue North	East - West	80	40 - 66	2 - 3	4,100 - 7,100
6th Avenue North	East - West	50 - 80	26 - 50	1 - 2	3,200 - 8,800
1st Avenue South	East - West	80	32 - 50	1 - 2	6,300 - 12,800
6th Avenue South	East - West	80	32 - 50	1 - 2	400 - 700
8th Avenue South	East - West	80	30 - 50	1 - 2	300 - 500
North 13th Street	North - South	80	28 - 66	1 - 3	1,300 - 3,200
North 23rd Street	North - South	80	50	2	900 - 1,300
North 24th Street	North - South	80	50	2	1,200 - 1,900
North 25th Street	North - South	80	50	2	1,100 - 1,800
North 26th Street	North - South	80	50	2	2,100 - 3,600
North 27th Street	North - South	80 - 90	30 - 53	1 - 2	3,200 - 8,900
South 27th Street	North - South	80	27 - 51	1 - 2	1,300 - 2,500
North 28th Street	North - South	80	40 - 52	2	5,600 - 8,000
South 28th Street	North - South	80	23 - 52	1 - 2	600 - 1,400
North 29th Street	North - South	80	50 - 51	2	5,400 - 5,800
North 30th Street	North - South	80	34 - 51	1 - 2	4,000 - 4,100
North 31st Street	North - South	80	50	2	1,700 - 1,900
South 31st Street	North - South	80	35 - 50	1 - 2	700 - 1,300
North 32nd Street	North - South	80	40 - 50	2	1,900 - 4,200
South 34th Street	North - South	80	50	2	300 - 600
South 37th Street	North - South	80	50	2	300
5th Street West	North - South	70	40	2	4,000
8th Street West	North - South	35 - 100	30 - 62	1 - 3	1,900 - 3,900

TABLE 1 (Concluded)

STREET AND TRAFFIC CHARACTERISTICS
ARTERIAL STREET SYSTEM

Street	Major Directions	Right of Way (Feet)	Pavement Width (Feet)	Effective Traffic Lanes (One Direction)	Daily Traffic Volume(1)
13th Street West	North - South	60	25 - 43	1 - 2	1,800 - 4,900
15th Street West	North - South		25 - 60	2 - 3	100 - 400
16th Street West	North - South	60	30 - 48	1 - 2	(2)
17th Street West	North - South	60	22 - 42	1 - 2	700 - 4,400
24th Street West	North - South	60	22 - 34	1	1,600 - 4,200

(1) Minimum and maximum 24-hour traffic counts made on each street.

(2) Nominal traffic count or no count made.

TABLE 2

DAILY AND PEAK HOUR TRAFFIC
MAJOR STREET SYSTEM

Location	Two-Way Average Weekday Volume		Peak Hour Directional Traffic*			
	24-Hour	Peak Hour	Vehicles	Direction	Percent of Two-Way Peak Hour Traffic	Percent of Two-Way Average Daily Traffic
External Cordon Line						
Station 1 - Montana Highway 3	1,076	82	48	Eastbound	58.5	4.5
Station 2 - Rimrock Road	1,104	100	57	Eastbound	57.0	5.2
Station 3 - Grand Avenue	1,096	88	46	Westbound	52.3	4.2
Station 4 - Broadwater Avenue	309	40	21	Eastbound	52.5	6.8
Station 5 - Central Avenue	968	69	38	Westbound	55.1	3.9
Station 6 - King Avenue	969	85	48	Eastbound	56.5	5.0
Station 8 - Interstate 90	5,154	382	215	Westbound	56.3	4.2
Station 9 - Frontage Road	950	90	52	Eastbound	57.8	5.5
Station 11 - Billings Boulevard	827	88	56	Northbound	63.6	6.8
Station 12 - U. S. 87	7,515	626	346	Westbound	55.3	4.6
Station 13 - Old U. S. 10	1,312	89	50	Eastbound	56.2	3.8
Station 14 - U. S. 10 & 87	12,440	869	566	Eastbound	65.1	4.5
Screen Line A						
13th Street & N.P.R.R. Underpass	5,145	478	255	Southbound	53.4	5.0
21st Street & N.P.R.R. Tracks	2,322	231	130	Northbound	56.1	5.6
27th Street & N.P.R.R. Tracks	6,379	551	304	Southbound	55.2	4.8
28th Street & N.P.R.R. Tracks	4,108	357	232	Northbound	65.0	5.6
29th Street & N.P.R.R. Tracks	5,393	473	289	Southbound	61.2	5.4
6th Street West & N.P.R.R. Underpass	6,197	627	338	Southbound	53.9	5.4
U. S. 10 & N.P.R.R. Overpass	5,315	543	274	Westbound	50.5	5.2
Moore Lane & N.P.R.R. Tracks	4,249	431	222	Northbound	51.4	5.2
King Avenue & N.P.R.R. Tracks	2,288	200	111	Northbound	55.5	4.8

TABLE 2 (Concluded)

DAILY AND PEAK HOUR TRAFFIC
MAJOR STREET SYSTEM

Location	Two-Way Average Weekday Volume		Peak Hour Directional Traffic*			
	24-Hour	Peak Hour	Vehicles	Direction	Percent of Two-Way Peak Hour Traffic	Percent of Two-Way Average Daily Traffic
Screen Line B						
Montana Route 3	1,283	97	53	Eastbound	55.1	4.1
Airport Road & North 27th Street	3,075	238	123	Southbound	51.5	4.0
Rimrock Road	3,359	353	307	Eastbound	86.9	9.1
Poly Drive	4,351	503	391	Westbound	77.8	9.0
Grandview Boulevard	3,408	445	415	Eastbound	93.3	12.2
Parkhill Drive	2,418	267	139	Eastbound	52.2	5.7
Grand Avenue	12,005	1,174	772	Westbound	65.8	6.4
Lewis Avenue	1,831	210	160	Westbound	76.0	8.7
Broadwater Avenue	8,295	736	492	Westbound	66.8	5.9
Montana Avenue	8,241	725	529	Westbound	72.9	6.4

*-Where Available

TABLE 3

COMPOSITION OF TRAFFIC AT THE EXTERNAL CORDON AND SCREEN LINES

Location	Average Daily Volume	Percent of Total Volume			
		Passenger Cars	Single Unit Trucks	Combination Trucks	Buses
External Cordon Line					
Station 1 - Montana Highway 3	1,076	71.0	16.8	11.8	0.4
Station 2 - Rimrock Road	1,104	84.3	13.9	1.8	0.0
Station 3 - Grand Avenue	1,096	87.6	11.9	0.5	0.0
Station 4 - Broadwater Avenue	309	54.4	43.8	1.8	0.0
Station 5 - Central Avenue	968	78.7	20.8	0.5	0.0
Station 6 - King Avenue	969	58.8	38.3	2.9	0.0
Station 8 - Interstate 90	5,154	78.9	13.2	7.6	0.3
Station 9 - Frontage Road	950	63.5	33.7	2.4	0.4
Station 11 - Billings Boulevard	827	55.0	44.6	0.3	0.1
Station 12 - U. S. 87	7,515	72.0	21.7	6.3	0.0
Station 13 - Old U. S. 10	1,312	67.1	30.1	2.8	0.0
Station 14 - U. S. 10 & 87	12,440	76.3	20.0	3.6	0.1
Screen Line A					
13th Street & N.P.R.R. Underpass	5,145	57.9	31.7	9.7	0.7
21st Street & N.P.R.R. Tracks	2,322	76.3	23.4	0.3	0.0
27th Street & N.P.R.R. Tracks	6,379	79.6	19.6	0.6	0.2
28th Street & N.P.R.R. Tracks	4,108	86.2	13.4	0.3	0.1
29th Street & N.P.R.R. Tracks	5,393	82.8	15.9	0.6	0.7
6th Street West & N.P.R.R. Underpass	6,197	81.1	18.5	0.4	0.0
U. S. 10 & N.P.R.R. Overpass	5,315	82.6	16.1	0.9	0.4
Moore Lane & N.P.R.R. Tracks	4,249	73.1	25.6	1.1	0.2
King Avenue & N.P R.R. Tracks	2,288	64.4	31.7	3.5	0.4

TABLE 3 (Concluded)

COMPOSITION OF TRAFFIC AT THE EXTERNAL
CORDON AND SCREEN LINES

Location	Average Daily Volume	Percent of Total Volume			
		Passenger Cars	Single Unit Trucks	Combination Trucks	Buses
Screen Line B					
Montana Route 3	1,283	76.4	16.0	7.6	0.0
Airport Road & North 27th Street	3,075	88.4	11.3	0.2	0.1
Rimrock Road	3,359	87.4	11.8	0.5	0.3
Poly Drive	4,351	92.2	7.5	0.1	0.2
Grandview Boulevard	3,408	91.4	7.9	0.2	0.5
Parkhill Drive	2,418	92.4	7.5	0.1	0.0
Grand Avenue	12,005	89.5	10.3	0.1	0.1
Lewis Avenue	1,831	88.1	11.4	0.1	0.4
Broadwater Avenue	8,295	89.3	10.2	0.4	0.1
Montana Avenue	8,241	81.4	17.6	0.6	0.4

TABLE 4

DWELLING UNIT EXPANSION FACTORS

Enumeration District Number	A Number of Addresses Counted	B Number of Samples Selected	C Vacant, Demolished or Commercial Samples	D Interviews Missed (Sickness, Absence or Refusal)	E Additional Samples Secured	F Dwelling Unit Expansion Factor	G Adjusted Number of Dwelling Units
1	243	41	6	1	1	6.1	214
2	228	38	3	0	3	6.0	228
2P	370	62	3	1	6	6.1	390
3	294	49	5	1	1	6.1	268
4	376	62	5	8	1	7.1	355
5	313	52	11	0	2	6.0	258
6	301	50	3	3	2	6.4	294
7	234	39	4	1	1	6.2	217
8	345	58	2	0	1	6.0	342
9	670	112	4	1	1	6.0	648
10N	239	40	0	1	0	6.1	238
10P	717	120	4	4	0	6.1	683
11	816	136	2	2	0	6.1	805
12	339	57	3	3	0	6.3	321
13	243	41	1	0	3	5.9	254
14	185	31	1	0	0	6.0	180
15	429	72	6	3	0	6.2	390
16	280	47	10	1	1	6.1	226
17	306	51	2	3	3	6.4	313
18	325	54	0	0	2	6.0	336
19	640	107	2	1	2	6.0	636
20N	647	108	3	2	0	6.1	628
20P	43	7	0	0	0	6.1	43
21	502	84	2	0	0	6.0	492
22	621	104	1	3	1	6.1	616
23N	148	25	0	0	0	5.9	148
23P	489	82	1	0	2	6.0	498
24	650	108	1	1	5	6.1	677
25	315	53	6	2	2	6.2	291
26	253	42	0	0	2	6.0	264
27	298	50	1	1	5	6.1	323

TABLE 4 (Concluded)

DWELLING UNIT EXPANSION FACTORS

Enumeration District Number	A Number of Addresses Counted	B Number of Samples Selected	C Vacant, Demolished or Commercial Samples	D Interviews Missed (Sickness, Absence or Refusal)	E Additional Samples Secured	F Dwelling Unit Expansion Factor	G Adjusted Number of Dwelling Units
28	255	43	1	1	0	6.1	250
29	291	49	2	1	1	6.1	287
30	327	55	3	1	2	6.1	323
31	304	51	2	2	5	6.2	322
32	333	56	8	1	9	6.1	342
33	283	47	4	2	9	6.3	315
34	333	56	7	1	0	6.1	293
35	268	45	4	1	0	6.1	244
36	262	44	4	0	1	6.0	246
37	271	45	4	5	0	6.9	248
38	279	47	8	0	10	5.9	289
39	297	50	11	2	0	6.3	233
40	311	52	17	1	0	6.1	207
41	302	50	6	0	0	6.0	264
42	3	1	0	0	0	3.0	3
42N	7	1	0	0	0	7.0	7
42P	141	24	2	1	0	6.1	128
42R	15	3	0	0	0	5.0	15
43	344	57	2	2	3	6.3	353
44	67	11	4	0	0	6.1	43
49N	38	6	0	1	0	7.6	38
49P	9	2	0	0	0	4.5	9
50	303	51	2	3	0	6.3	290
51	623	104	3	1	1	6.1	616
52	315	53	3	0	0	5.9	295
53	187	31	0	2	1	6.5	195
54N	35	6	0	0	0	5.8	35
54P	99	17	0	2	0	6.6	99
61	3	1	0	0	0	3.0	3
Total	18,164	3,040	189	73	89		17,568

TABLE 5

SUMMARY OF TRIPS REPORTED IN HOME INTERVIEWS
TRIPS TO ALL PURPOSES BY MODE

Purpose to	Auto Drivers		Auto, Truck and Taxi Passengers		Bus and School Bus Passengers		All Modes	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Home	43,898	34.2	23,048	37.8	1,718	47.1	68,664	35.6
Work	19,011	14.8	3,334	5.5	444	12.2	22,789	11.8
Business	8,526	6.6	1,748	2.9	85	2.3	10,359	5.4
Medical - Dental	1,078	0.8	868	1.4	48	1.3	1,994	1.0
School	1,480	1.2	3,306	5.4	1,139	31.2	5,925	3.1
Social - Recreation	12,327	9.6	18,681	30.6	97	2.7	31,105	16.1
Change Travel Mode	79	0.1	196	0.3	-	-	275	0.1
Eat Meal	6,830	5.3	1,962	3.2	6	0.2	8,798	4.5
Shopping	17,515	13.6	7,260	11.9	109	3.0	24,884	12.9
Serve Passenger	17,667	13.8	624	1.0	-	-	18,291	9.5
Total	128,411	100.0	61,027	100.0	3,646	100.0	193,084	100.0

TABLE 6

SUMMARY OF TRIPS REPORTED IN HOME INTERVIEWS
TRIP PURPOSE OTHER THAN HOME BY MODE

Purpose	Auto Drivers		Auto, Truck and Taxi Passengers		Bus and School Bus Passengers		All Modes	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Work	27,750	21.6	5,941	9.7	845	23.2	34,536	17.9
Business	12,661	9.8	2,653	4.4	158	4.3	15,472	8.0
Medical - Dental	1,645	1.3	1,336	2.2	78	2.1	3,059	1.6
School	2,307	1.8	5,171	8.5	2,159	59.2	9,637	5.0
Social - Recreation	20,368	15.9	29,784	48.8	151	4.2	50,303	26.1
Change Travel Mode	108	0.1	316	0.5	6	0.2	430	0.2
Eat Meal	7,685	6.0	2,833	4.6	12	0.3	10,530	5.4
Shopping	28,863	22.5	12,019	19.7	237	6.5	41,119	21.3
Serve Passenger	27,024	21.0	974	1.6	-	0.0	27,998	14.5
Total	128,411	100.0	61,027	100.0	3,646	100.0	193,084	100.0

TABLE 7

SUMMARY OF TRIPS REPORTED AT EXTERNAL CORDON
AUTO DRIVERS AND CAR OCCUPANCY BY DRIVER'S PURPOSE

	Local Trips			Through Trips			Total Trips		
Purpose	Number	Percent	Average Occupancy	Number	Percent	Average Occupancy	Number	Percent	Average Occupancy
Work	5,461	28.0	1.4	342	14.1	1.2	5,803	26.5	1.4
Business	4,317	22.1	1.8	405	16.8	2.1	4,722	21.5	1.9
Medical - Dental	602	3.1	2.4	12	0.5	3.6	614	2.8	2.4
School	44	0.2	2.4	11	0.5	2.3	55	0.3	2.4
Social - Recreation	6,280	32.2	2.6	1,538	63.6	3.2	7,818	35.7	2.7
Change Travel Mode	33	0.2	2.9	5	0.2	3.7	38	0.2	3.0
Eat Meal	517	2.7	2.1	21	0.9	2.3	538	2.4	2.1
Shopping	1,612	8.3	2.7	39	1.6	2.4	1,651	7.5	2.7
Serve Passenger	630	3.2	2.3	43	1.8	2.8	673	3.1	2.3
Total	19,496	100.0		2,416	100.0		21,912	100.0	
Average			2.1			2.8			2.1

TABLE 8

TOTAL TRIPS IN THE SURVEY AREA - 1961

Mode	Internal		External Local		External Through		Total	
	Number	Percent	Number	Percent	Number	Percent	Number	Percent
Drivers								
Auto	128,879	58.8	20,003(1)	41.9	2,235(1)	31.2	151,117	55.1
Truck	23,644	10.8	6,536	13.7	903	12.6	31,083	11.3
Taxi	1,814	0.8	-	-	-	-	1,814	0.7
Total Drivers	154,337	70.4	26,539	55.6	3,138	43.8	184,014	67.1
Passengers								
Auto	60,908	27.8	21,235	44.4	4,031	56.2	86,174	31.5
Transit (Bus)	1,977	0.9	-	-	-	-	1,977	0.7
Taxi	355	0.2	-	-	-	-	355	0.1
Truck	42	0.0	-	-	-	-	42	0.0
School Bus	1,639	0.7	-	-	-	-	1,639	0.6
Total Passengers	64,921	29.6	21,235	44.4	4,031	56.2	90,187	32.9
Grand Total	219,258	100.0	47,774	100.0	7,169	100.0	274,201	100.0

(1) Includes Taxis

TABLE 9

POPULATION TRENDS

Year	Population United States	Population Montana	Percent Mont./U.S.	Population Yellowstone County	Percent Yell. Co./Mont.	Population Billings Urban Area	Percent Billings Area/County	Population Remainder of County
1900	76,212,168	243,329	0.319	6,212	2.55			
1910	92,228,496	376,053	0.408	22,944	6.10			
1920	106,021,537	548,889	0.660	29,600	5.39			
1930	123,202,624	537,606	0.436	30,785	5.73	18,065	58.7	12,720
1940	132,164,569	559,456	0.423	41,182	7.36	25,220	61.3	15,962
1950	151,325,798	591,024	0.391	55,875	9.45	44,839	80.3	11,036
1960	179,323,175	674,767	0.376	79,016	11.71	66,135	83.6	12,901
1965	194,700,000	711,000	0.365	91,000	12.80	77,400	85.0	13,600
1970	211,000,000	755,000	0.358	105,300	13.95	91,100	86.5	14,200
1975	230,400,000	797,000	0.346	119,500	15.00	105,200	88.0	14,300
1981	257,000,000	870,000	0.338	140,000	16.10	125,000	89.3	15,000

United States Population From
Statistical Abstract of the United States - 1958

	1965	1970	1975	1980
I	198,950,000	219,474,000	243,880,000	272,557,000
II	195,747,000	213,810,000	235,246,000	259,981,000
III	193,643,000	208,199,000	225,552,000	245,409,000
IV	191,517,000	202,541,000	215,790,000	230,834,000

Montana Population From Current Population Reports,
U. S. Dept. of Commerce, Series P-25, No. 160

	1960	1965	1970
I	671,000	711,000	755,000
II	661,000	693,000	730,000
III	666,000	704,000	748,000
IV	661,000	698,000	715,000

TABLE 10

1960 AND ESTIMATED 1981 POPULATION
IN THE BILLINGS URBAN AREA

	1960	1981
City (Present Limits)	52,851	66,200
Remainder--Internal Area	8,563	35,800
Total Internal Area	61,414	102,000
Lockwood	1,303	4,000
Bench	3,273	11,000
Billings West	145	8,000
Total	66,135	125,000

TABLE 11

PROJECTIONS OF POPULATION DENSITY
BY ENUMERATION DISTRICT

Enumeration District	Total Area (Acres)	Population		Gross Residential Area (Acres)		Net Residential Area (Acres)		Population Per Gross Residential Acre		Population Per Net Residential Acre	
		1960	Estimated 1981	1960	Estimated 1981	1960	Estimated 1981	1960	Estimated 1981	1960	Estimated 1981
1	121.0	644	500	32.7	18.1	32.0	18.1	19.7	27.6	20.1	27.6
2-N	94.5	890	730	43.5	23.6	20.4	21.0	20.4	30.8	43.6	34.8
2-P	73.5	1,016	1,110	70.6	66.2	64.4	66.2	14.4	16.8	15.8	16.8
3	56.0	773	710	38.0	33.6	37.3	33.6	20.3	21.1	20.7	21.1
4	63.0	757	660	12.6	9.5	12.6	9.5	60.0	70.0	60.1	69.5
5	59.0	687	690	27.7	27.7	26.9	27.7	24.8	25.0	25.5	24.9
6	83.0	959	970	58.9	55.5	58.2	55.5	16.3	17.4	16.5	17.5
7	158.1	928	1,190	104.3	100.0	67.8	95.0	8.9	11.9	13.7	12.5
8	139.7	1,238	1,240	139.7	139.7	123.1	130.0	8.9	8.9	10.1	9.5
9	324.4	2,304	2,990	314.7	314.7	202.1	310.0	7.4	9.5	11.4	9.6
10-N	175.5	883	1,580	173.7	173.7	92.8	165.0	5.1	9.1	9.5	9.6
10-P	332.0	2,609	3,760	275.6	265.0	157.8	260.0	9.4	14.2	16.5	14.5
11	447.0	2,927	4,690	438.0	438.0	166.9	420.0	6.7	10.7	17.5	11.2
12	122.9	1,100	1,320	122.9	122.9	98.3	120.0	8.9	10.7	11.2	11.0
13	64.0	777	800	60.8	60.8	59.5	60.0	12.8	13.1	13.1	13.3
14	35.1	553	560	30.9	30.9	30.7	30.9	17.9	18.0	18.0	18.1
15	56.7	830	840	32.9	32.9	32.7	32.9	25.2	25.4	25.4	25.5
16	164.8	620	620	21.4	21.4	21.3	21.3	29.0	29.0	29.1	29.1
17	110.8	893	890	51.0	51.0	45.6	50.0	17.6	17.5	19.6	17.8
18	81.9	1,063	1,300	77.8	74.0	70.2	73.0	13.7	17.6	15.1	17.8
19	180.0	2,205	2,490	176.4	168.0	147.2	162.0	12.5	14.8	15.0	15.4
20	361.0	2,677	4,250	343.0	343.0	167.8	265.0	7.8	12.4	16.0	16.0
21	200.0	1,954	2,680	200.0	180.0	123.0	170.0	9.8	14.9	15.9	15.8
22	322.0	2,502	3,780	273.7	273.7	154.0	235.0	9.1	13.8	16.2	16.1
23-N	144.3	494	1,850	108.2	108.2	33.0	105.0	4.6	17.1	15.0	17.6
23-P	344.0	2,028	2,630	172.0	172.0	124.5	165.0	11.8	15.3	16.3	15.9

TABLE 11 (Continued)

PROJECTIONS OF POPULATION DENSITY
BY ENUMERATION DISTRICT

Enumeration District	Total Area (Acres)	Population 1960	Population Estimated 1981	Gross Residential Area (Acres) 1960	Gross Residential Area (Acres) Estimated 1981	Net Residential Area (Acres) 1960	Net Residential Area (Acres) Estimated 1981	Population Per Gross Residential Acre 1960	Population Per Gross Residential Acre Estimated 1981	Population Per Net Residential Acre 1960	Population Per Net Residential Acre Estimated 1981
24	392.6	2,643	4,160	353.3	274.0	203.8	270.0	7.5	15.2	13.0	15.4
25	73.4	1,104	1,120	71.2	71.2	70.3	71.0	15.5	15.8	15.7	15.8
26	69.1	918	960	62.2	62.2	60.4	62.0	14.7	15.5	15.2	15.5
27	74.6	1,016	1,080	63.4	63.4	58.7	63.0	16.1	17.1	17.3	17.1
28	56.0	844	860	56.0	56.0	55.1	56.0	15.1	15.4	15.3	15.4
29	64.8	978	1,020	63.5	63.5	61.6	63.0	15.4	16.1	15.9	16.2
30	64.8	1,008	1,010	62.9	62.9	62.6	62.7	16.0	16.0	16.1	16.1
31	64.8	871	930	63.5	63.5	60.7	63.0	13.7	14.7	14.3	14.8
32	61.6	974	980	55.4	55.4	54.9	55.0	17.6	17.7	17.7	17.8
33	81.9	1,001	1,090	59.8	59.8	56.1	59.0	16.7	18.2	17.8	18.5
34	102.3	1,249	1,400	78.8	78.8	67.1	78.0	14.0	17.8	18.6	17.9
35	74.5	967	990	64.8	64.8	62.5	64.0	14.9	15.3	15.5	15.5
36	55.3	872	930	49.2	49.2	47.4	49.0	17.7	19.0	18.4	19.0
37	75.8	836	960	51.5	51.5	47.5	51.0	16.2	18.7	17.6	18.8
38	44.2	732	760	33.1	33.1	32.8	33.0	22.1	23.1	22.3	23.0
39	39.7	804	810	29.8	24.8	24.5	24.5	27.0	32.7	32.8	33.1
40	116.2	757	830	34.9	34.9	23.2	30.0	21.7	23.9	32.6	27.7
41	92.7	966	1,210	86.2	74.2	66.6	72.0	11.2	16.3	14.5	16.8
Sub-Total Billings - City	5,918.5	52,851	65,930	4,740.5	4,547.3	3,285.9	4,327.9	11.1	14.5	16.1	15.2

TABLE 11 (Concluded)

PROJECTIONS OF POPULATION DENSITY
BY ENUMERATION DISTRICT

Enumeration District	Total Area (Acres)	Population		Gross Residential Area (Acres)		Net Residential Area (Acres)		Population Per Gross Residential Acre		Population Per Net Residential Acre	
		1960	Estimated 1981	1960	Estimated 1981	1960	Estimated 1981	1960	Estimated 1981	1960	Estimated 1981
42-N1	230.0	49	2,120	230.0	230.0						
42-N2	15.0	0	140	15.0	11.0	2.5	141.2	0.2	21.9	19.6	16.0
42-N3	45.0	0	0	0.0	0.0						
42-P	870.0	554	7,310	870.0	870.0	32.0	456.9	0.6	8.4	17.3	16.0
42-R	460.0	257	1,880	299.0	299.0	9.2	117.5	0.9	6.3	27.9	16.0
42-S	230.0	29	300	230.0	230.0	2.0	18.8	0.1	1.3	14.5	16.0
43	290.0	1,176	1,200	203.0	203.0	88.2	92.3	5.4	5.9	13.3	13.0
44	280.0	178	250	70.0	70.0	10.8	15.6	2.5	3.6	16.5	16.0
49-N	835.0	164	240	42.0	42.0	9.5	15.0	3.9	5.8	17.3	16.0
49-P	470.0	13	610	470.0	470.0	2.2	50.8	0.1	1.3	5.9	12.0
Billings West	840.0	20	270	546.0	546.0	0.8	16.9	0.1	0.5	25.0	16.0
50	1,140.0	1,104	7,010	855.0	855.0	72.5	438.1	1.3	8.2	15.2	16.0
51	780.0	2,544	6,260	764.0	764.0	154.0	391.2	3.3	8.2	16.5	16.0
52	280.0	1,428	2,790	210.0	210.0	73.8	174.4	6.8	13.3	19.3	16.0
53	280.0	665	1,490	112.0	112.0	48.8	93.1	5.9	13.3	13.6	16.0
54-N	350.0	144	890	175.0	175.0	8.8	55.6	0.8	5.1	16.4	16.0
54-P	480.0	238	2,920	384.0	384.0	24.8	243.3	0.6	7.6	9.6	12.0
Sub-Total - Outside Billings	7,875.0	8,563	35,680	5,475.0	5,471.0	539.9	2,320.7	1.6	6.5	15.9	15.4
Total - Study Area	13,793.5	61,414	101,610	10,215.5	10,018.3	3,825.8	6,648.6	6.0	10.2	16.1	15.3

TABLE 11-A

LAND USE BY ZONES - 1957 AND 1981

Zone Number	Number of Acres - 1957					Number of Acres - 1981					Total Acres
	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	
001	5.0	9.2	0.8	4.8	0.0	4.3	9.9	0.8	4.8	0.0	19.8
002	1.8	8.3	5.0	4.7	0.0	1.0	9.1	5.0	4.7	0.0	19.8
003	8.2	2.6	3.9	3.7	1.4	5.7	5.3	5.1	3.7	0.0	19.8
004	5.0	8.3	1.9	3.9	0.7	3.8	10.2	1.9	3.9	0.0	19.8
005	1.0	16.5	0.0	2.3	0.0	0.5	17.0	0.0	2.3	0.0	19.8
006	11.5	5.7	2.6	0.0	0.0	8.2	9.0	2.6	0.0	0.0	19.8
007	1.1	7.7	3.8	0.0	0.6	1.0	8.4	3.8	0.0	0.0	13.2
008	0.0	9.0	1.2	1.6	0.0	0.0	9.0	1.2	1.6	0.0	11.8
009	0.1	10.2	4.3	0.0	0.0	0.1	10.2	4.3	0.0	0.0	14.6
101	28.7	0.0	0.0	0.8	0.0	28.7	0.0	0.0	0.8	0.0	29.5
102	38.6	0.0	0.0	53.7	0.0	38.6	0.0	0.0	53.7	0.0	92.3
103	137.0	4.6	0.1	3.9	21.1	149.6	13.9	0.1	3.1	0.0	166.7
111	57.7	0.0	0.0	0.2	1.8	59.5	0.0	0.0	0.2	0.0	59.7
112	14.0	0.2	0.0	47.3	31.8	18.5	1.0	0.0	72.3	1.5	93.3
113	62.0	0.2	0.0	50.5	31.1	83.0	0.2	0.0	50.5	10.1	143.8
114	110.5	0.4	0.0	0.0	65.2	160.5	0.4	0.0	0.0	15.2	176.1
121	143.1	3.6	0.1	3.7	16.2	152.9	10.0	0.1	3.7	0.0	166.7
122	90.2	0.1	0.0	26.4	19.7	109.9	0.1	0.0	26.4	0.0	136.4
131	68.6	0.0	0.0	0.0	44.8	102.1	0.0	0.0	0.0	11.3	113.4
132	0.0	0.0	0.0	79.9	0.0	0.0	0.0	0.0	79.9	0.0	79.9
133	29.8	0.0	0.0	8.9	46.2	71.9	0.0	0.0	10.0	3.0	84.9
141	0.0	34.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.4	34.4
142	75.1	0.8	0.0	0.0	47.5	117.0	6.4	0.0	0.0	0.0	123.4
143	38.3	1.1	0.0	38.0	75.7	105.0	1.1	0.0	38.0	9.0	153.1
144	59.7	1.5	0.0	13.9	105.9	132.4	20.6	0.0	28.0	0.0	181.0
145	17.5	0.0	0.0	5.2	93.0	70.5	0.0	0.0	5.2	40.0	115.7
146	56.3	0.1	0.0	2.6	196.6	191.6	0.1	0.0	5.5	58.4	255.6
151	31.4	1.0	0.0	22.5	88.1	119.5	1.0	0.0	22.5	0.0	143.0
152	59.2	0.2	0.0	0.0	86.4	80.2	0.2	0.0	0.0	65.4	145.8
153	89.5	0.0	0.0	3.4	141.4	182.9	0.0	0.0	3.4	48.0	234.3

TABLE 11-A (Continued)

LAND USE BY ZONES - 1957 AND 1981

Zone Number	Number of Acres - 1957					Number of Acres - 1981					Total Acres
	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	
161	17.8	0.0	0.0	5.7	592.5	337.2	0.0	0.0	13.2	265.6	616.0
162	32.2	0.0	0.0	50.8	339.5	272.6	0.0	0.0	50.8	99.1	422.5
171	0.0	0.0	0.0	296.0	0.0	0.0	0.0	0.0	296.0	0.0	296.0
172	0.0	2.8	0.0	0.9	235.1	0.0	2.8	0.0	0.9	235.1	238.8
173	0.0	0.0	0.0	0.0	196.1	0.0	0.0	0.0	0.0	196.1	196.1
201	11.5	7.6	8.0	1.7	0.0	6.6	12.5	8.0	1.7	0.0	28.8
202	13.6	6.3	0.2	2.7	0.0	13.6	6.3	0.2	2.7	0.0	22.8
211	35.9	0.2	0.0	2.4	0.1	36.0	0.2	0.0	2.4	0.0	38.6
212	30.4	0.9	0.0	3.9	3.4	33.8	0.9	0.0	3.9	0.0	38.6
213	52.3	0.2	0.0	3.9	0.1	52.4	0.2	0.0	3.9	0.0	56.5
214	55.9	0.3	0.0	0.3	0.0	55.9	0.3	0.0	0.3	0.0	56.5
221	25.4	2.8	1.6	0.0	0.0	23.0	4.2	2.6	0.0	0.0	29.8
222	44.5	0.8	0.0	0.2	3.7	48.0	1.0	0.0	0.2	0.0	49.2
223	30.5	6.5	6.1	0.0	1.8	24.9	11.0	9.0	0.0	0.0	44.9
231	83.8	0.9	0.0	0.0	10.7	84.7	10.7	0.0	0.0	0.0	95.4
232	75.8	0.1	0.0	1.0	15.0	90.4	0.1	0.0	1.4	0.0	91.9
233	11.9	1.1	0.4	3.2	82.7	85.7	10.0	0.4	3.2	0.0	99.3
234	29.2	2.7	0.0	19.1	21.8	41.7	12.0	0.0	19.1	0.0	72.8
235	0.2	8.5	0.0	0.0	0.0	0.2	8.5	0.0	0.0	0.0	8.7
236	0.3	6.3	0.0	0.0	1.0	0.3	7.3	0.0	0.0	0.0	7.6
241	72.2	1.8	0.3	5.5	0.4	72.6	1.8	0.3	5.5	0.0	80.2
242	87.1	5.0	2.1	21.8	2.2	87.1	7.2	2.1	21.8	0.0	118.2
243	49.3	2.8	0.6	6.0	53.2	84.3	5.6	1.0	6.0	15.0	111.9
244	50.5	0.1	0.2	0.3	34.7	70.5	0.2	0.2	0.3	14.6	85.8
251	34.4	2.3	33.8	0.0	39.7	48.4	5.0	45.8	0.0	11.0	110.2
252	46.2	0.5	2.1	13.4	92.1	69.3	2.0	5.0	13.4	64.6	154.3
253	0.0	4.1	0.0	0.0	65.6	0.0	8.2	18.0	0.0	43.5	69.7
261	0.0	8.0	38.5	0.0	44.2	0.0	16.0	48.5	0.0	26.2	90.7
262	1.0	0.0	0.0	0.0	217.5	24.0	0.0	20.0	0.0	174.5	218.5
263	15.7	22.4	11.9	0.0	264.2	160.7	22.5	20.0	0.0	111.0	314.2
264	0.0	0.0	0.0	0.0	108.7	3.6	0.0	0.0	0.0	105.1	108.7
265	0.0	0.0	0.3	0.0	50.8	1.8	0.0	0.3	0.0	49.0	51.1

TABLE 11-A (Continued)

LAND USE BY ZONES - 1957 AND 1981

Zone Number	Number of Acres - 1957					Number of Acres - 1981					Total Acres
	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	
271	0.0	0.0	0.0	133.7	0.0	0.0	0.0	0.0	133.7	0.0	133.7
272	35.6	1.9	0.0	11.1	280.0	260.0	4.0	0.0	11.1	53.5	328.6
281	63.6	0.2	0.0	35.1	60.3	111.0	1.0	0.0	35.1	12.1	159.2
282	65.6	0.8	0.0	37.8	83.2	137.0	2.0	0.0	37.8	10.6	187.4
283	48.2	0.0	0.0	0.0	115.9	93.1	0.0	0.0	0.0	70.4	164.1
291	104.2	0.9	0.0	14.2	39.9	132.0	10.0	0.0	14.2	3.0	159.2
292	81.7	3.5	1.2	9.1	91.9	133.0	12.0	1.2	9.1	32.1	187.4
293	57.0	0.6	0.0	11.8	66.0	115.0	1.5	0.0	11.8	7.1	135.4
294	0.3	0.0	0.0	0.0	169.4	51.0	0.0	0.0	0.0	118.7	169.7
301	0.0	0.0	13.4	0.0	2.7	0.0	1.5	14.6	0.0	0.0	16.1
302	1.0	0.6	31.5	0.0	8.2	2.0	1.0	38.3	0.0	0.0	41.3
311	44.9	1.8	1.5	3.4	0.0	43.0	3.7	1.5	3.4	0.0	51.6
312	20.2	0.0	0.0	0.0	3.6	23.6	0.0	0.0	0.0	0.2	23.6
313	36.0	3.5	0.0	0.0	6.2	40.7	5.0	0.0	0.0	0.0	45.7
321	26.2	3.1	12.3	0.0	81.3	65.9	6.0	20.3	12.0	18.7	122.9
322	35.9	3.8	0.0	2.6	80.6	81.0	3.8	0.0	6.0	32.1	122.9
323	22.2	0.0	0.0	0.0	223.6	100.0	0.0	0.0	0.0	145.8	245.8
324	10.0	0.0	0.0	0.0	297.0	60.0	0.0	0.0	0.0	247.0	307.0
331	22.4	13.2	5.7	0.7	163.8	90.0	26.2	12.0	1.5	76.1	205.8
332	67.6	1.4	0.0	14.7	154.6	150.0	3.5	0.0	28.0	56.8	238.3
333	2.2	0.0	0.0	0.0	452.0	85.0	0.0	0.0	0.0	369.2	454.2
341	35.8	9.7	0.2	1.1	191.8	71.6	20.0	1.0	1.1	144.9	238.6
342	0.8	0.0	0.0	0.0	696.2	10.7	0.0	0.0	0.0	686.3	697.0
401	0.0	0.8	24.3	0.6	0.0	0.0	1.5	23.6	0.6	0.0	25.7
402	57.4	1.6	0.8	6.0	0.0	56.5	2.5	0.8	6.0	0.0	65.8
411	5.4	8.5	6.9	0.1	0.5	5.0	9.2	7.1	0.1	0.0	21.4
412	12.3	1.7	6.9	0.0	0.5	11.8	2.2	7.4	0.0	0.0	21.4
413	6.4	1.5	8.9	0.0	8.4	6.2	5.0	12.0	0.0	2.0	25.2
414	52.1	0.3	0.2	0.2	12.4	58.8	6.0	0.2	0.2	0.0	65.2

TABLE 11-A (Continued)

LAND USE BY ZONES - 1957 AND 1981

Zone Number	Number of Acres - 1957					Number of Acres - 1981					Total Acres
	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	
421	47.4	0.1	0.0	18.5	3.7	51.1	0.1	0.0	18.5	0.0	69.7
422	36.9	0.1	0.0	6.1	4.2	36.9	4.3	0.0	6.1	0.0	47.3
423	39.6	0.0	0.2	0.0	6.8	41.4	4.0	0.2	0.0	1.0	46.6
431	0.0	1.6	50.8	0.0	12.1	0.0	2.0	55.0	0.0	7.5	64.5
432	0.5	0.0	162.4	20.1	7.2	0.5	0.0	169.6	20.1	0.0	190.2
441	0.4	0.0	134.8	0.0	56.6	0.4	0.0	150.0	0.0	41.4	191.8
442	8.6	4.2	0.0	88.4	154.8	14.1	8.5	0.0	88.4	145.0	256.0
451	31.8	0.4	2.4	0.0	230.1	150.0	8.0	30.0	0.0	76.7	264.7
452	3.0	0.0	0.0	0.5	282.4	40.0	0.0	0.0	0.5	245.4	285.9
461	0.0	0.0	153.3	0.0	0.0	0.0	0.0	153.3	0.0	0.0	153.3
462	16.3	0.0	0.0	0.0	183.2	96.0	0.0	0.0	0.0	103.5	199.5
501	0.7	6.0	12.9	0.0	2.7	0.7	7.0	14.6	0.0	0.0	22.3
502	20.0	8.1	9.8	0.4	1.8	17.2	11.1	11.4	0.4	0.0	40.1
511	5.6	8.8	11.4	0.0	3.5	4.9	11.8	12.6	0.0	0.0	29.3
512	3.1	0.9	16.8	2.4	3.0	3.0	1.5	19.3	2.4	0.0	26.2
521	0.0	7.8	14.4	0.0	0.0	0.0	7.8	14.4	0.0	0.0	22.2
522	12.6	6.4	6.9	1.4	2.8	10.0	9.9	8.8	1.4	0.0	30.1
531	0.0	0.0	12.9	0.0	0.0	0.0	0.0	12.9	0.0	0.0	12.9
532	10.5	7.8	15.3	0.5	16.0	10.5	13.0	21.3	0.5	4.8	50.1
533	8.2	3.7	17.9	0.5	2.4	8.2	5.1	18.9	0.5	0.0	32.7
534	0.8	3.1	14.8	1.0	47.7	0.8	5.1	20.8	1.0	39.7	67.4
541	0.0	0.0	0.0	155.6	0.0	0.0	0.0	0.0	155.6	0.0	155.6
542	2.1	4.4	0.5	59.5	68.3	2.1	6.8	0.5	59.5	65.9	134.8
551	54.2	1.5	1.5	17.0	2.0	52.2	3.5	3.5	17.0	0.0	76.2
552	40.4	0.3	0.3	0.0	19.4	40.4	0.3	0.3	0.0	19.4	60.4
553	27.5	0.3	0.5	3.0	32.8	27.5	0.3	0.5	3.0	32.8	64.1
554	18.5	1.6	1.7	0.0	15.1	20.0	1.6	1.7	0.0	13.6	36.9

TABLE 11-A (Concluded)

LAND USE BY ZONES - 1957 AND 1981

Zone Number	Number of Acres - 1957					Number of Acres - 1981					Total Acres
	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	Residential	Commercial	Industrial	Public and Semi-Public	Undeveloped	
561	8.1	3.8	0.7	0.3	0.2	8.1	4.0	0.7	0.3	0.0	13.1
562	3.3	6.9	2.0	0.0	0.9	3.3	7.8	2.0	0.0	0.0	13.1
571	23.3	2.2	0.0	0.0	0.7	23.3	2.9	0.0	0.0	0.0	26.2
572	23.9	2.3	0.0	0.0	0.0	22.9	3.3	0.0	0.0	0.0	26.2
573	24.8	1.5	0.6	10.1	0.0	23.8	2.5	0.6	10.1	0.0	37.0
574	27.7	1.6	0.0	7.2	0.5	27.7	2.1	0.0	7.2	0.0	37.0
581	61.1	2.5	0.0	12.7	0.0	61.1	2.5	0.0	12.7	0.0	76.3
582	61.7	5.6	0.0	0.0	4.8	61.7	10.4	0.0	0.0	0.0	72.1
583	8.3	0.0	0.0	9.8	64.4	16.0	0.0	0.0	9.8	56.7	82.5
591	0.0	0.0	0.0	26.4	189.4	0.0	0.0	0.0	26.4	189.4	215.8
592	0.9	0.0	0.0	169.9	7.5	2.1	0.0	0.0	169.9	6.3	178.3
Total	3,695.3	373.6	888.4	1,714.2	8,309.0	6,700.6	574.4	1,069.2	1,793.9	4,842.4	14,980.5 (1)

(1) Total acreage differs from that shown in Table 11 since boundaries of enumeration districts as defined by the Bureau of Census did not permit inclusion of additional area north of the rimrocks. Area not included in Table 11 is undevelopable or part of the Billings Airport, however, and was not a factor in estimates of growth factors.

Note: These data based on 1957 land use map prepared by Billings City Plan Commission. Adjustments based on 1960 census data were made to the totals shown in Table 11 to reflect, as closely as possible, new construction in the three-year period. Area devoted to streets and alleys has been prorated among other classifications of land use.

TABLE 12

FACTORS USED IN EXPANSION OF TRAFFIC DATA

Zone	Estimated Growth Factor by Type of Land Use at Destination: Residential	Manufacturing and Non-Manufacturing Industry	Services, Storage and Commercial	Public, Quasi-Public and Open Space	Trip Ends 1961	Weighted Average Growth Factor	Estimated Trip Ends 1981
001	1.11	1.55	1.40	1.80	3,750	1.49	5,598
002	1.08	1.55	1.40	3.26	7,348	1.78	13,044
003	1.02	1.55	1.40	1.80	1,133	1.29	1,464
004	1.10	1.55	1.40	1.80	6,147	1.52	9,344
005	0.97	1.55	1.40	1.80	15,347	1.46	22,359
006	0.97	1.55	1.40	1.80	2,670	1.28	3,417
007	1.10	1.55	1.40	1.80	3,422	1.40	4,801
008	1.00	1.55	1.40	1.80	11,745	1.55	18,221
009	1.02	1.55	1.40	1.80	3,542	1.44	5,106
101	1.11	-	1.15	-	1,654	1.13	1,861
102	1.10	-	1.14	1.80	3,569	1.47	5,229
103	1.26	1.55	2.00	1.25	7,981	1.41	11,230
111	1.32	-	-	1.30	2,255	1.34	3,026
112	1.37	-	1.89	1.80	3,443	1.73	5,958
113	1.21	-	1.26	1.80	3,289	1.33	4,376
114	1.21	-	1.26	1.20	4,279	1.21	5,165
121	1.32	1.03	2.00	1.30	8,623	1.60	13,811
122	1.54	-	1.60	1.52	4,352	1.58	6,864
131	1.32	-	-	1.30	2,761	1.33	3,684
132	-	-	-	1.80	765	1.77	1,354
133	1.43	-	-	1.41	1,420	1.45	2,066
141	1.59	1.87	2.28	2.17	11,352	2.24	25,465
142	1.59	-	1.65	1.58	3,354	1.57	5,277
143	2.69	-	2.28	2.66	2,112	2.66	5,616
144	1.59	-	2.00	2.72	3,148	1.88	5,907
145	3.30	-	3.42	3.26	2,241	3.23	7,260
146	3.85	-	3.99	3.80	2,282	3.91	8,929
151	6.27	-	6.50	6.19	1,055	6.55	6,908
152	3.13	-	3.25	3.10	2,249	3.15	7,074
153	2.31	1.96	2.40	2.28	3,819	2.32	8,841
161	15.39	13.09	15.96	15.21	1,031	15.21*	15,680

TABLE 12 (Continued)

FACTORS USED IN EXPANSION OF TRAFFIC DATA

Zone	Estimated Growth Factor by Type of Land Use at Destination: Residential	Manufacturing and Non-Manufacturing Industry	Services Storage and Commercial	Public, Quasi-Public and Open Space	Trip Ends 1961	Weighted Average Growth Factor	Estimated Trip Ends 1981
162	5.50	-	-	5.43	1,302	5.64	7,338
171	-	3.74	4.57	4.35	2,191	3.90	8,544
172	-	-	1.89	-	200	1.94	389
201	1.10	0.94	1.89	1.80	3,317	1.67	5,535
202	1.11	1.55	1.89	1.80	3,974	1.41	5,615
211	1.11	-	1.15	1.10	2,062	1.11	2,297
212	1.15	-	1.89	1.14	2,414	1.22	2,954
213	1.15	-	1.20	1.14	2,655	1.13	2,998
214	1.11	-	1.15	1.10	2,644	1.13	2,995
221	1.11	1.87	2.28	-	1,334	1.63	2,172
222	1.12	-	1.16	1.11	2,002	1.14	2,288
223	1.15	1.87	2.28	-	2,836	1.77	5,024
231	1.37	-	3.42	1.36	4,796	1.44	6,906
232	1.21	-	1.26	1.80	3,669	1.25	4,570
233	1.65	1.87	2.28	1.80	2,249	2.01	4,529
234	1.65	1.40	2.00	1.80	5,022	1.82	9,132
235	1.65	1.64	2.00	-	6,552	1.98	12,976
236	1.65	-	1.71	1.63	2,321	1.69	3,912
241	1.15	-	1.20	1.14	5,273	1.17	6,194
242	1.26	1.87	2.28	1.25	5,261	1.37	7,191
243	2.36	1.87	2.28	2.34	3,476	2.30	7,981
244	1.54	-	2.28	1.52	2,406	1.56	3,747
251	2.14	1.87	2.28	-	1,903	2.21	4,200
252	1.54	1.64	2.00	1.52	3,886	1.70	6,607
253, 261, 262	-	1.87	2.28	2.17	2,188	2.13	4,667
263	4.62	2.81	-	4.56	636	4.49	2,857
264, 265	15.12	-	-	-	166	16.27*	2,700
271	-	-	1.89	1.80	520	1.77	922

TABLE 12 (Continued)

FACTORS USED IN EXPANSION OF TRAFFIC DATA

Zone	Estimated Growth Factor by Type of Land Use at Destination: Residential	Manufacturing and Non-Manufacturing Industry	Services, Storage and Commercial	Public, Quasi-Public and Open Space	Trip Ends 1961	Weighted Average Growth Factor	Estimated Trip Ends 1981
272	4.40	1.64	4.57	4.35	3,677	4.31	15,859
281	1.98	1.68	1.89	1.80	4,814	1.90	9,158
282	2.53	2.15	2.62	2.50	4,378	2.51	11,001
283	2.20	1.87	2.28	2.17	3,257	2.27	7,380
291	1.43	1.22	2.00	1.41	5,784	1.53	8,860
292	1.65	-	2.00	1.63	5,394	1.68	9,089
293	1.98	1.68	2.06	1.96	3,904	1.94	7,572
294	11.00	-	11.41	2.17	831	5.48	4,555
301	-	1.31	1.60	-	686	1.44	985
302	2.69	1.55	1.89	-	938	1.77	1,661
311	1.12	-	1.60	1.11	2,021	1.24	2,499
312	1.15	-	-	-	719	1.21	868
313	1.26	1.31	1.60	1.25	2,905	1.43	4,141
321	4.40	3.74	4.57	-	1,381	4.38	6,055
322	2.25	-	2.34	2.23	2,170	2.29	4,973
323	3.30	2.81	3.42	-	1,626	3.29	5,357
324	4.12	3.51	-	0.54	206	2.88	593
331	2.53	1.55	1.89	2.50	3,234	2.35	7,594
332	2.53	-	2.62	2.50	3,708	2.55	9,446
333	42.33	1.55	-	-	77	23.12*	1,780
341	2.20	3.74	4.57	4.35	3,538	3.14	11,093
342	15.12	-	-	2.17	68	34.71*	2,360
401	1.10	1.31	1.60	1.52	1,440	1.56	2,251
402	1.15	0.98	1.60	1.14	2,906	1.20	3,475
411	1.11	1.55	1.89	1.10	2,867	1.70	4,888
412	1.11	1.55	1.89	1.10	712	1.54	1,100
413	1.11	1.55	1.89	-	474	1.64	776
414	1.15	0.98	1.89	1.14	1,812	1.23	2,223
421	1.26	-	1.32	1.25	1,550	1.27	1,970
422	1.37	-	3.42	1.36	1,179	1.47	1,737
423	1.37	-	3.42	-	927	1.46	1,353

TABLE 12 (Continued)

FACTORS USED IN EXPANSION OF TRAFFIC DATA

Zone	Estimated Growth Factor by Type of Land Use at Destination: Residential	Manufacturing and Non-Manufacturing Industry	Services, Storage and Commercial	Public, Quasi-Public and Open Space	Trip Ends 1961	Weighted Average Growth Factor	Estimated Trip Ends 1981
431	-	1.12	1.37	1.30	1,750	1.15	2,020
432	-	-	2.28	-	130	1.69	220
441	1.65	1.55	1.71	-	533	1.66	883
442	0.99	1.87	2.28	2.17	812	1.55	1,261
451	6.93	1.55	1.89	1.80	920	6.15	5,654
452	6.93	-	-	-	217	6.77	1,469
461	6.93	0.94	-	-	603	1.49	900
462	6.93	5.89	-	6.85	908	6.90	6,264
501	-	1.55	1.89	-	803	1.86	1,497
502	0.88	1.55	1.89	1.80	3,384	1.52	5,146
511	0.88	1.55	1.89	-	1,485	1.20	1,782
512	0.99	1.55	1.89	-	1,594	1.51	2,406
521	0.93	1.64	2.00	-	1,386	1.64	2,267
522	0.82	1.64	2.00	-	3,642	1.49	5,435
531	-	1.64	2.00	1.90	700	2.01	1,404
532	1.37	1.55	1.89	1.36	2,284	1.62	3,733
533	-	1.55	1.89	-	869	1.56	1,355
534	-	1.64	2.00	1.90	1,664	1.77	2,952
541	-	-	1.89	1.80	504	1.80	905
542	-	-	1.89	-	71	1.44	102
551	1.04	1.55	1.89	1.80	3,107	1.27	3,956
552	0.99	0.84	-	-	1,692	0.99	1,671
553	1.12	-	1.16	1.11	978	1.13	1,102
554	1.12	0.95	1.16	-	645	1.06	684
561	1.10	1.55	1.89	1.09	1,369	1.67	2,283
562	1.04	1.64	1.99	1.03	1,320	1.69	2,250
571	1.11	-	1.89	1.10	1,907	1.26	2,399
572	1.04	1.64	2.00	1.03	1,785	1.28	2,290
573	1.11	1.55	1.89	1.80	2,743	1.60	4,388
574	1.11	-	1.89	1.80	4,901	1.63	7,973

TABLE 12 (Concluded)

FACTORS USED IN EXPANSION OF TRAFFIC DATA

Zone	Estimated Growth Factor by Type of Land Use at Destination: Residential	Manufacturing and Non-Manufacturing Industry	Services, Storage and Commercial	Public, Quasi-Public and Open Space	Trip Ends 1961	Weighted Average Growth Factor	Estimated Trip Ends 1981
581	1.12	0.95	1.89	1.80	6,985	1.58	11,059
582	1.11	-	1.89	1.80	4,268	1.38	5,875
583	2.20	-	2.28	2.17	577	2.19	1,264
591	-	-	-	1.80	40	1.80	72
592	1.10	-	-	-	61	1.20	73
Internal Total					335,213	1.88	629,821
External Stations							
1	-	-	-	-	993	1.55	1,544
2	-	-	-	-	989	4.15	4,107
3	-	-	-	-	1,031	3.04	3,138
4	-	-	-	-	297	4.81	1,430
5	-	-	-	-	916	4.07	3,727
6	-	-	-	-	901	4.47	4,029
8	-	-	-	-	5,792	1.57	9,091
9	-	-	-	-	848	1.60	1,355
11	-	-	-	-	795	1.38	1,100
12	-	-	-	-	7,192	3.04	21,898
13	-	-	-	-	1,144	3.64	4,163
14	-	-	-	-	11,917	3.20	38,174
External Total					32,815	2.86	93,756
Grand Total					368,028	1.97	723,577

*-Exclusive of simulated trips.

TABLE 13

COMPARISON OF 1961 AVERAGE DAILY TRAFFIC ASSIGNMENTS WITH 1961 TRAFFIC COUNTS

Location	Traffic Counts	First Assignment	Second Assignment	Second Assignment as Percent of Traffic Counts
Screenline A				
King Avenue and N.P.R.R. Tracks	2,288	2,536	2,536	111
Moore Lane and N.P.R.R. Tracks	4,249	3,268	3,268	77
U. S. 10 W and N.P.R.R. Overpass	5,315	5,136	5,136	97
6th Street West and N.P.R.R. Underpass	6,197	6,376	6,564	106
Southwest Total	18,049	17,316	17,504	97
29th Street and N.P.R.R. Tracks	5,393	6,788	4,932	91
28th Street and N.P.R.R. Tracks	4,108	3,036	4,690	114
27th Street and N.P.R.R. Tracks	6,379	2,468	2,428	38
Central Total	15,880	12,292	12,050	76
21st Street and N.P.R.R. Tracks	2,322	1,744	1,820	78
13th Street and N.P.R.R. Underpass	5,145	6,184	6,172	120
East Total	7,467	7,928	7,992	107
Total Screenline A	41,396	37,536	37,546	91

TABLE 13 (Continued)

COMPARISON OF 1961 AVERAGE DAILY TRAFFIC ASSIGNMENTS WITH 1961 TRAFFIC COUNTS

Location	Traffic Counts	First Assignment	Second Assignment	Second Assignment as Percent of Traffic Counts
Screenline B				
Montana Route 3	1,283	556	556	43
Airport Road and North 27th Street	3,075	2,580	2,588	84
Rimrock Road	3,359	3,548	2,512	75
Poly Drive	4,351	6,572	7,464	172
Grandview Boulevard	3,408	2,448	2,188	64
McDonnel and Colton Boulevards	712	688	700	98
Sub-Total	16,188	16,392	16,008	99
Beverly Hills Road	949	2,768	2,804	295
Parkhill Drive	2,418	2,256	2,404	99
Grand Avenue	12,005	4,160	12,112	100
Alderson and Burlington Avenues	2,389	1,200	2,376	99
Lewis and Clark Avenues	3,051	17,316	2,700	89
Yellowstone Avenue	1,291	368	452	35
Sub-Total	22,103	28,068	22,848	103
Wyoming and Broadwater Avenues	9,525	5,028	9,580	101
Custer and Terry Avenues	1,649	1,532	1,536	93
Miles and Howard Avenues	1,565	968	968	62
Cook, St. Johns and Montana Avenues	11,551	10,600	10,436	90
Sub-Total	24,290	18,128	22,520	93

TABLE 13 (Concluded)

COMPARISON OF 1961 AVERAGE DAILY TRAFFIC
ASSIGNMENTS WITH 1961 TRAFFIC COUNTS

Location	Traffic Counts	First Assignment	Second Assignment	Second Assignment as Percent of Traffic Counts
Screenline B (Concluded)				
1st Avenue South	10,572	11,172	11,328	107
2nd, 3rd, 4th and 5th Avenues South	1,400	580	580	41
6th Avenue South	421	416	416	99
7th Avenue South	500	516	516	103
Sub-Total	12,893	12,684	12,840	100
8th Avenue South	379	276	276	73
State Avenue	1,329	1,096	1,176	88
Stone Street	500	956	856	171
King Avenue	152	124	68	45
Sub-Total	2,360	2,452	2,376	101
Total Screenline B	77,834	77,724	76,592	98

TABLE 14

COMPARISON OF 1961 AND ESTIMATED 1981 DAILY TRAFFIC VOLUMES ON THE RECOMMENDED ARTERIAL STREET SYSTEM

Street	Major Directions	1961 Daily Traffic Volume(1)	1981 Daily Traffic Volume(3)
Billings Boulevard	North - South	800 - 900	900 - 1,100
Belknap Avenue	East - West	800	1,400
Broadwater Avenue	East - West	300 - 8,500	1,400 - 20,200
Calhoun Lane	North - South	1,900	1,300 - 9,400
Central Avenue	East - West	900 - 6,100	3,700 - 13,400
Colton Boulevard	East - West	800 - 2,300	4,700 - 9,000
Division Street	North - South	3,800	3,000 - 13,400
Garden Avenue	North - South	(2)	100 - 1,400
Grand Avenue	East - West	1,000 - 12,400	3,100 - 21,600
Grandview Boulevard	East - West	3,700	6,300 - 7,400
Jackson Street	North - South	900	1,200 - 6,200
King Avenue	East - West	200 - 1,600	3,700 - 13,400
Lewis Avenue	East - West	1,800	2,100 - 6,000
Locust Street	North - South	300	2,600 - 4,500
Monad Road	East - West	(2)	1,400 - 10,800
Montana Avenue	North - South	6,700 - 10,800	3,100 - 13,200
Orchard Lane	North - South	1,900	1,100 - 3,700
Parkhill Drive	East - West	1,000 - 2,500	4,200 - 9,000
Poly Drive	East - West	2,900 - 6,900	1,600 - 15,600
Rehberg Lane	North - South	600 - 1,000	1,000 - 5,800
Rimrock Road	East - West	800 - 2,900	4,100 - 14,300
Riverside Road	North - South	600	1,700 - 4,900
St. Johns Avenue	East - West	(2)	2,400 - 3,300
State Avenue	East - West	1,200 - 1,900	1,500 - 8,700
Sugar Avenue	North - South	500	600 - 1,000
Virginia Lane	North - South	(2)	1,600
Washington Street	North - South	400	1,000 - 6,400
Zimmerman Trail	North - South	700	2,200
Montana Highway 3	East - West	1,000	1,600 - 3,200
1st Avenue North	East - West	8,000 - 12,500	8,900 - 14,500
2nd Avenue North	East - West	3,900 - 6,500	1,100 - 9,700
3rd Avenue North	East - West	3,700 - 5,300	1,200 - 6,100
4th Avenue North	East - West	4,100 - 7,100	8,000 - 14,400
6th Avenue North	East - West	3,200 - 8,800	7,600 - 15,300
1st Avenue South	East - West	6,300 - 12,800	12,100 - 18,700
6th Avenue South	East - West	400 - 700	300 - 900
8th Avenue South	East - West	300 - 500	800 - 2,000

TABLE 14 (Concluded)

COMPARISON OF 1961 AND ESTIMATED 1981 DAILY TRAFFIC VOLUMES ON THE RECOMMENDED ARTERIAL STREET SYSTEM

Street	Major Directions	1961 Daily Traffic Volume(1)	1981 Daily Traffic Volume(3)
North 13th Street	North - South	1,300 - 3,200	3,200 - 12,600
North 15th Street	North - South	(2)	1,400 - 10,000
North 25th Street	North - South	1,100 - 1,800	1,300 - 2,300
North 27th Street	North - South	3,200 - 8,900	6,400 - 13,100
South 27th Street	North - South	1,300 - 2,500	2,100 - 6,200
North 28th Street	North - South	5,600 - 8,000	7,000 - 14,500
South 28th Street	North - South	600 - 1,400	2,000 - 7,000
North 30th Street	North - South	4,000 - 4,100	1,900 - 5,400
South 31st Street	North - South	700 - 1,300	400 - 3,100
North 32nd Street	North - South	1,900 - 4,200	2,500 - 10,500
South 34th Street	North - South	300 - 600	800 - 1,600
South 37th Street	North - South	300	4,100 - 4,700
5th Street West	North - South	4,000	2,100 - 5,700
6th Street West	North - South	(2)	2,700 - 8,300
8th Street West	North - South	1,900 - 3,900	3,900 - 9,000
12th Street West	North - South	(2)	3,600 - 7,000
13th Street West	North - South	1,800 - 4,900	2,000 - 4,500
15th Street West	North - South	100 - 400	2,300 - 7,000
16th Street West	North - South	(2)	2,600 - 6,300
17th Street West	North - South	700 - 4,400	3,000 - 9,100
19th Street West	North - South	(2)	2,800 - 7,600
24th Street West	North - South	1,600 - 4,200	2,600 - 10,700

(1) Minimum and maximum 24-hour traffic counts made on each street.

(2) Nominal traffic count or no count made.

(3) Minimum and maximum estimated 24-hour traffic volume on each street.

TABLE 15

POTENTIAL SOURCE OF FUNDS

Construction Priority	Total Estimated Construction Cost	Source of Funds						
		Federal Aid Funds						
		Federal Aid Interstate		Federal Aid Primary		Federal Aid Secondary		
		Federal	Other*	Federal	Other*	Federal	Other*	City Only
I	$ 5,687,000	-	-	$275,500	$275,500	$ 684,500	$ 684,500	$ 3,767,000
II	5,695,000	$734,000**	$82,000**	497,500	497,500	384,500	384,500	3,115,000
III	4,501,000	-	-	-	-	145,000	145,000	4,211,000
IV	4,151,000	-	-	-	-	-	-	4,151,000
Total	$20,034,000	$734,000**	$82,000**	$773,000	$773,000	$1,214,000	$1,214,000	$15,244,000

*-Other: State, County and City.

**-Indicates cost of East Interchange assuming that railway remains in present location. If railway is relocated, add $624,000 ($561,600 Federal, $62,400 Other).

Note: These costs include an allowance of 20 percent for engineering and contingencies.

TABLE 16

ESTIMATED COST OF RECOMMENDED IMPROVEMENTS

On Street	Between Streets		Type of Street	Roadway Width in Feet: Pavement Present	Pavement Proposed	Right of Way Present	Right of Way Proposed	Cost Estimates in Thousands of Dollars: Priority First	Second	Third	Fourth
Billings Boulevard	U. S. 10, 212	King Avenue	Secondary	22	44	80-100	80-100	-	-	$ 151	-
Broadwater Avenue	Division Street	17th Street West	Major II	27-44	48-77	70	70-90	$ 512	-	-	-
Broadwater Avenue	17th Street West	Parkview Drive	Major II	24-28	24-28	70-90	70-90	-	$ 507	-	-
Calhoun Lane	U S. 10, 212	King Avenue	Secondary	26-28	44	60	60	-	-	-	$ 140
Central Avenue	Sixth Street West	16th Street West	Major II	26-32	48	60	60	405	-	-	-
Central Avenue	16th Street West	Bridge at B.B.W.A. Canal	Major II	21-32	48	60	60	-	674	-	-
Colton Boulevard	17th Street West	38th Street West	Secondary	20-28	44	60	60	-	-	555	-
Daniel Street	Regal Street	King Avenue	Secondary	0-24	44	0-50	60	-	-	-	242
Division Street	North 32nd Street	Grand Avenue	Major II	0-50	50-60	0-80	80-90	16	-	-	-
Elevation Street	North 28th Street	North 30th Street	Major II	0-36	36	0-60	60	43	-	-	-
Grand Avenue	Division Street	Rehberg Lane	Major II	23-60	48-77	60-80	60-90	1,038	-	-	-
Grandview Boulevard	North 30th Street	Fifth Street West	Major II	0-30	36	0-60	60	56	-	-	-
Hallowell Lane	State Avenue	King Avenue	Secondary	0-28	44	60	60	-	-	-	218
Hoover Avenue	Poly Drive	Colton Boulevard	Major II	24	44	40	60	-	-	104	-
Jackson Street	State Avenue	King Avenue	Secondary	22-35	44	60	60	-	-	-	227
King Avenue	Garden Avenue	Billings Boulevard	Secondary	19-25	44	60	60	-	-	-	568
King Avenue	Billings Boulevard	Edwards Street	Secondary	19-25	44	60	60	-	-	139	-
King Avenue	Daniel Street	19th Street West	Major II	19	44	60	60	-	-	-	79
King Avenue	19th Street West	24th Street West	Major II	25	44	60	60	-	139	-	-
King Avenue	24th Street West	Bridge at B.B W.A. Canal	Major II	30	44	60	60	-	-	284	-
Kratz Lane	Sugar Avenue	Jackson Street	Secondary	0	44	0-60	60	-	-	-	196
Lewis Avenue	Division Street	17th Street West	Secondary	23-39	44-48	60	60	-	-	333	-
Louise Lane	Poly Drive	Lillis Lane	Secondary	0-30	44	0-60	60	-	-	-	290
Minnesota Avenue	South 13th Street	South 15th Street	Major I	40	48	80	80	-	100	-	-
Minnesota Avenue	South 15th Street	South 20th Street	Major I	40	48	80	80	86	-	-	-
Monad Road	Moore Lane	24th Street West	Major II	0-30	44	0-60	60	-	-	458	-
Monad Road	24th Street West	Bridge at B.B.W.A. Canal	Secondary	0	44	0	60	-	-	-	197
Montana Avenue	North 14th Street	North 16th Street	Secondary	28-34	36	80	80	-	43	-	-
Montana Avenue (Extension)	Montana Avenue and First Avenue North at North 21st Street		Major II	0	24	0	50	37	-	-	-
Montana Avenue	at Division Street and Custer Avenue		Major II	40-60	40-60	74-80	74-80	3	-	-	-
Moore Lane	Central Avenue	U. S. 10, 212	Secondary	24	44	60	60	-	-	150	-
Orchard Lane	U. S. 10, 212	King Avenue	Secondary	28	44	60	60	-	-	-	290
Parkhill Drive	North 32nd Street	17th Street West	Secondary	36-46	44-55	60	60-70	-	-	215	-
Parkview Drive	Lillis Lane	Broadwater Avenue	Secondary	24	44	60	60	-	-	-	106
Poly Drive	North 27th Street	38th Street West	Major II	25-38	36-48	60-80	60-80	1,182	-	-	-
Proposed Connection	U. S. 10, 212	King Avenue	Secondary	0	24	0	50	-	-	38	-
Regal Street	Central Avenue	Daniel Street Extension	Secondary	30	44	60	60	-	-	-	40
Rehberg Lane	Rimrock Road	Grand Avenue	Major II	20-35	44	60	60	-	-	382	-
Rimrock Road	North 27th Street	Brentwood Lane	Major II	21-34	48-55	60	60-70	883	-	-	-
Rimrock Road	Brentwood Lane	38th Street West	Major II	30-32	48	60	60	-	631	-	-
Riverside Road	State Avenue	King Avenue	Secondary	18	44	60	60	-	-	-	298
State Avenue	South 27th Street	First Avenue South	Major II	22-28	44	60	60	-	563	-	-
Sugar Avenue	State Avenue	King Avenue	Secondary	0-28	44	0-60	60	-	-	-	264

TABLE 16 (Continued)

ESTIMATED COST OF RECOMMENDED IMPROVEMENTS

On Street	Between Streets		Type of Street	Roadway Width in Feet: Pavement Present	Pavement Proposed	Right of Way Present	Right of Way Proposed	Cost Estimates in Thousands of Dollars: Priority First	Second	Third	Fourth
Vaughn Avenue	Jackson Street	Billings Boulevard	Secondary	0-30	44	0-60	60	-	-	-	$ 204
Virginia Lane	Rimrock Road	Poly Drive	Secondary	25	44	60	60	$ 41	-	-	-
Washington Street	State Avenue	King Avenue	Secondary	18-22	44	60	60	-	-	-	276
First Avenue North	U. S. 10, 212, 312, 87	North 16th Street	Major I	60	60-66	80	80	10	-	-	-
First Avenue North	North 34th Street	Division Street	Major II	56	56	80	80	46	-	-	-
First Avenue South	Minnesota Avenue	South 22nd Street	Major I	32	48	80	80	47	-	-	-
Second Avenue North	at North 35th Street and Division Street		-	50	0	80	80	1	-	-	-
Third Avenue North	U. S. 10, 312, 87	North 11th Street	Secondary	24	44	60	60	-	-	76	-
Fourth Avenue North	U. S. 10, 312, 87	North 16th Street	Major I	40-66	48-77	80	80-90	146	-	$ -	-
Sixth Avenue North	U. S. 10, 312, 87	North 32nd Street	Major II	27-50	44-77	50-80	80-90	292	-	-	-
Sixth Avenue South	South 25th Street	South 33rd Street	Secondary	32-40	44	80	80	-	-	-	29
Sixth Street West	Poly Drive	Parkhill Drive	Major II	0-30	40	0-70	70	100	-	-	-
Eighth Avenue South	South 31st Street	State Avenue	Secondary	30-32	44	80	80	-	-	-	41
Eighth Street West	Parkhill Drive	Clark Avenue	Secondary	30-32	44	60-80	60-80	-	$ 82	-	-
12th Street West	Grand Avenue	Central Avenue	Secondary	30	44	70	70	-	-	235	-
North 13th Street	Sixth Avenue North	Railway Underpass	Major I	28-40	36-44	80	80	-	195	-	-
13th Street West	Rimrock Road	Avenue E	Secondary	25-43	44	60	60	-	-	138	-
North 15th Street	Sixth Avenue North	Minnesota Avenue	Major I	30-44	36-44	60-80	60-80	-	789	-	-
15th Street West	Poly Drive	Central Avenue	Major II	0-36	48	0-60	60-70	-	710	-	-
16th Street West	Grand Avenue	Central Avenue	Secondary	30-48	44	60	60	269	-	-	-
17th Street West	Rimrock Road	Grand Avenue	Secondary	26	44	60	60	244	-	-	-
19th Street West	Poly Drive	King Avenue	Major II	0-30	44-48	0-60	60-70	-	-	1,064	-
24th Street West	Colton Boulevard	Grand Avenue	Secondary	22-34	44	60	60	-	-	179	-
24th Street West	Grand Avenue	King Avenue	Major II	27	44	60	60	-	446	-	-
North 27th Street	Sixth Avenue North	Fifth Avenue North	Major II	53	53	80	80	25	-	-	-
North 28th Street	B.B.W.A. Canal at North 27th Street	Montana Avenue	Major II	0-50	24-50	0-80	40-80	29	-	-	-
South 28th Street	Tenth Avenue South	South 27th Street Interchange	Major II	0-23	24-36	0-80	60-80	126	-	-	-
Canal Street	Broadwater Avenue	King Avenue	Secondary	0-24	44	0-60	60	-	-	-	341
North 32nd Street	Division Street Extension	Sixth Avenue North	Major II	40-50	55-77	80	80-90	11	-	-	-
North 33rd Street	at Division Street and Fourth Avenue North		-	50	0	80	80	1	-	-	-
North 34th Street	at Division Street and Third Avenue North		-	50	0	80	80	1	-	-	-
38th Street West	Rimrock Road	Colton Boulevard	Secondary	30	44	60	60	-	-	-	105
U. S. 10, 312, 87	Sixth Avenue North	First Avenue North	Major I	48	48-77	60-80	70-100	12	-	-	-
U. S. 87, 212	U. S. 10, 312, 87	New Fairgrounds Entrance	Major II	24-40	24-36	70-80	70-80	25	-	-	-
East Interchange* (Without Railway Relocation)			Major I	-	-	-	-	-	816	-	-
TOTALS								$5,687	$5,695	$4,501	$4,151

*-For cost of East Interchange with railway relocation, add $624,000.

Note: These costs include an allowance of 20 percent for engineering and contingencies.

TABLE 17

ESTIMATED RIGHT OF WAY

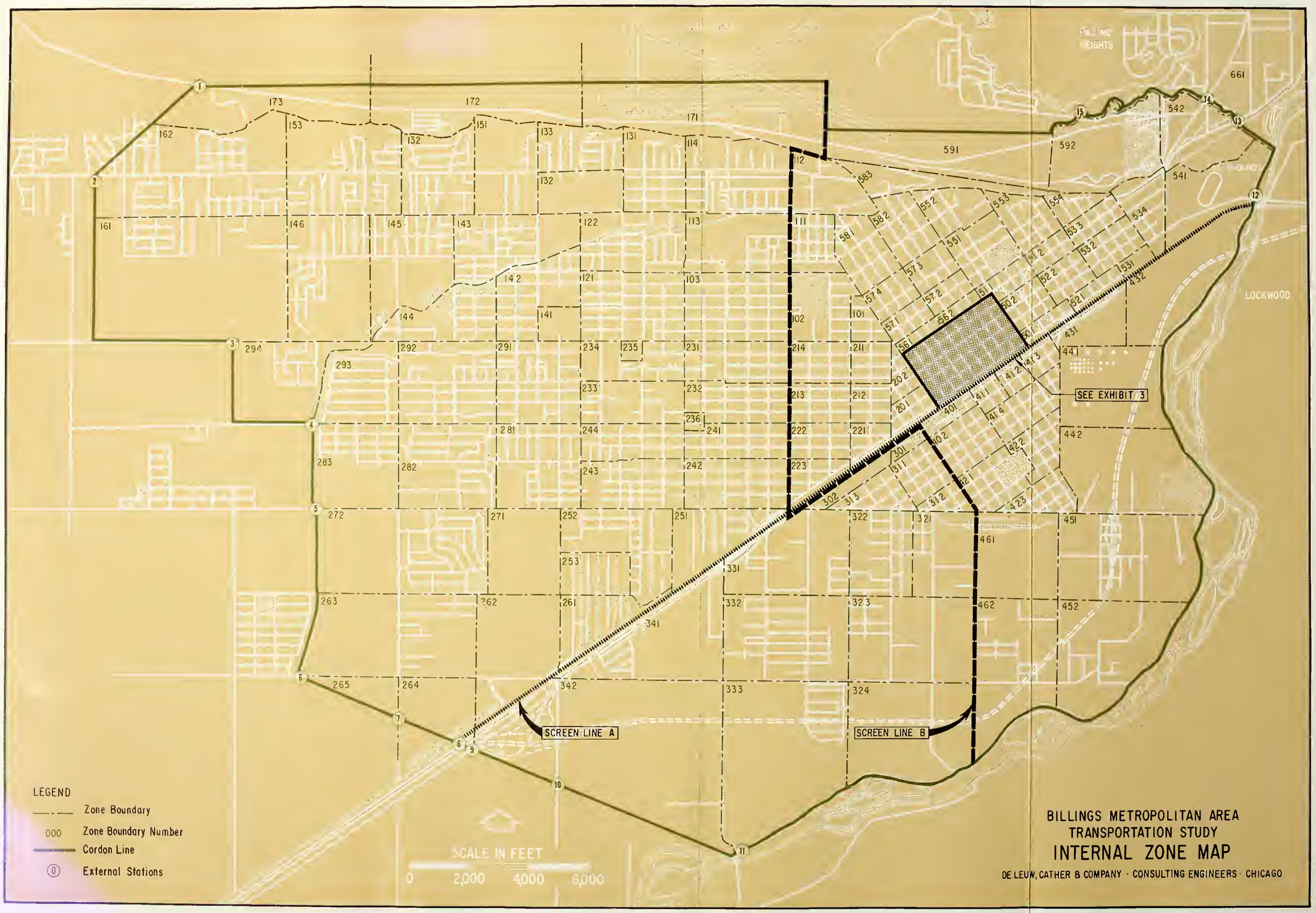
On Street	Between Streets		Estimated Right of Way Cost by Type of Improvement (Thousands of Dollars)			Total Estimated Cost of Right of Way by Priority (Thousands of Dollars)			
			Extension	Widening	Channelization	First	Second	Third	Fourth
Broadwater Avenue	Division Street	17th Street West	-	-	$143	$143	-	-	-
Colton Boulevard	17th Street West	38th Street West	$ 2	-	-	-	-	$ 2	-
Daniel Street	Regal Street	King Avenue	45	-	-	-	-	-	$45
Division Street	North 32nd Street	Grand Avenue	8	-	11	19	-	-	-
Elevation Street	North 28th Street	North 30th Street	35	-	-	35	-	-	-
Grand Avenue	Division Street	Rehberg Lane	-	$150	203	353	-	-	-
Hoover Avenue	Poly Drive	Colton Boulevard	-	95	-	-	-	95	-
Lewis Avenue	Division Street	17th Street West	-	-	14	-	-	14	-
Louise Lane	Poly Drive	Lillis Lane	23	-	-	-	-	-	23
Minnesota Avenue	South 13th Street	South 15th Street	-	-	4	-	$ 4	-	-
Montana Avenue	Montana Avenue and First Avenue North at North 21st Street		100	-	-	100	-	-	-
Parkhill Drive	North 32nd Street	17th Street West	-	-	15	-	-	15	-
Poly Drive	North 27th Street	38th Street West	-	-	26	26	-	-	-
Proposed Connection	U. S. 10, 212	King Avenue	42	-	-	-	-	42	-
Rimrock Road	North 27th Street	Brentwood Lane	-	-	15	15	-	-	-
Sixth Avenue North	U. S. 10, 312, 87	North 32nd Street	-	6	18	24	-	-	-
12th Street West	Grand Avenue	Central Avenue	-	22	-	-	-	22	-
North 15th Street	Sixth Avenue North	Minnesota Avenue	22	-	-	-	22	-	-
15th Street West	Poly Drive	Central Avenue	68	-	-	-	68	-	-
19th Street West	Poly Drive	King Avenue	-	-	7	-	-	7	-
North 32nd Street	Division Street Extension	Sixth Avenue North	-	-	13	13	-	-	-
U. S. 10, 312, 87	Sixth Avenue North	First Avenue North	-	-	3	3	-	-	-
U. S. 87, 212	U. S. 10, 312, 87	New Fairgrounds Entrance	-	-	10	10	-	-	-
			$345	$273	$482	$741	$94	$197	$68

EXHIBITS

EXHIBIT I

BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
GENERAL AREA MAP
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 2


BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
INTERNAL ZONE MAP
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO
LEGEND
Zone Boundary
000 Zone Boundary Number
Cordon Line
External Stations
SCALE IN FEET
0 2,000 4,000 6,000
SCREEN LINE A
SCREEN LINE B
SEE EXHIBIT 3
LOCKWOOD

BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

CENTRAL BUSINESS DISTRICT BLOCK AND ZONE MAP

DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 4

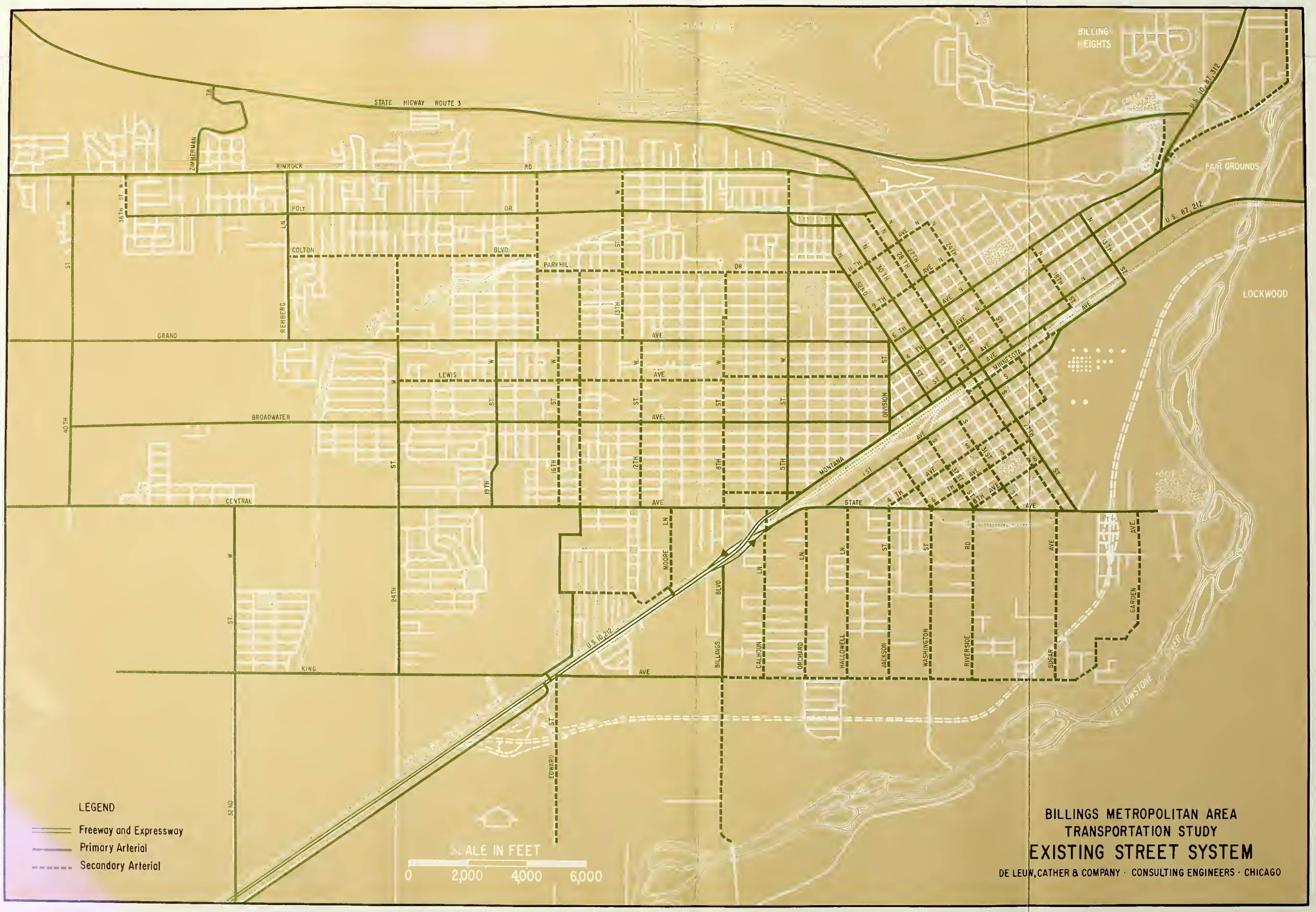

BILLING HEIGHTS
FAIR GROUNDS
LOCKWOOD
STATE HIGWAY ROUTE 3
U.S. 10, 87, 312
U.S. 87, 212
U.S. 10, 212
RIMROCK RD
ZIMMERMAN TR.
POLY DR.
COLTON BLVD.
PARKHILL DR.
GRAND AVE.
LEWIS AVE.
BROADWATER AVE.
CENTRAL AVE.
STATE AVE
KING AVE
MONTANA
MINNESOTA
DIVISION
REHBERG LN.
38TH ST. W.
40TH ST.
24TH ST. W.
32ND ST. W.
19TH ST.
16TH ST.
13TH ST.
12TH ST.
8TH ST.
5TH ST.
MOORE LN.
BILLINGS BLVD.
CALHOUN LN.
ORCHARD LN.
HALLOWELL LN.
JACKSON ST.
WASHINGTON ST.
RIVERSIDE RD.
SUGAR AVE
GARDEN AVE.
EDWARD ST.
YELLOWSTONE RIVER
LEGEND
Freeway and Expressway
Primary Arterial
Secondary Arterial
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
EXISTING STREET SYSTEM
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 5

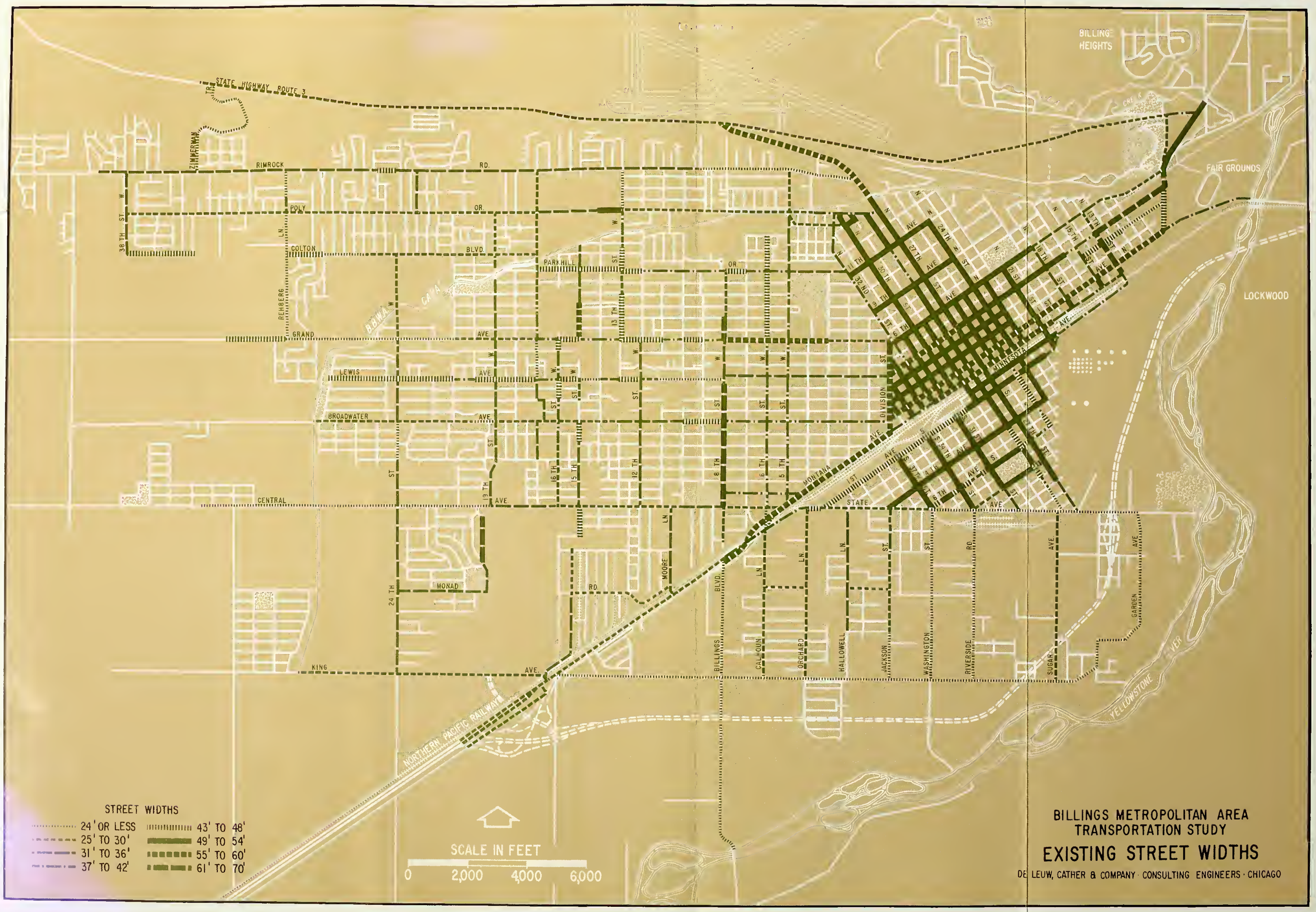

BILLINGS HEIGHTS
FAIR GROUNDS
LOCKWOOD
STATE HIGHWAY ROUTE 3
ZIMMERMAN TR.
RIMROCK RD.
POLY DR.
COLTON BLVD.
PARKHILL DR.
GRAND AVE.
LEWIS AVE.
BROADWATER AVE.
CENTRAL AVE.
MONAD RD.
KING AVE.
STATE AVE.
MONTANA
MINNESOTA
DIVISION ST.
38 TH ST. W.
REHBERG LN.
24 TH ST. W.
19 TH ST. W.
16 TH ST. W.
15 TH ST. W.
13 TH ST. W.
12 TH ST.
11 TH ST.
10 TH ST.
9 TH ST.
8 TH ST.
6 TH ST.
5 TH ST.
32 ND ST.
27 TH AVE.
24 TH ST.
18 TH ST.
16 TH ST.
13 TH ST.
MOORE LN.
BILLINGS BLVD.
CALHOUN LN.
ORCHARD LN.
HALLOWELL LN.
JACKSON ST.
WASHINGTON ST.
RIVERSIDE RD.
SUGAR AVE.
GARDEN AVE.
B.B.W.A.
CANAL
YELLOWSTONE RIVER
NORTHERN PACIFIC RAILWAY
STREET WIDTHS
24' OR LESS
25' TO 30'
31' TO 36'
37' TO 42'
43' TO 48'
49' TO 54'
55' TO 60'
61' TO 70'
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
EXISTING STREET WIDTHS
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 6

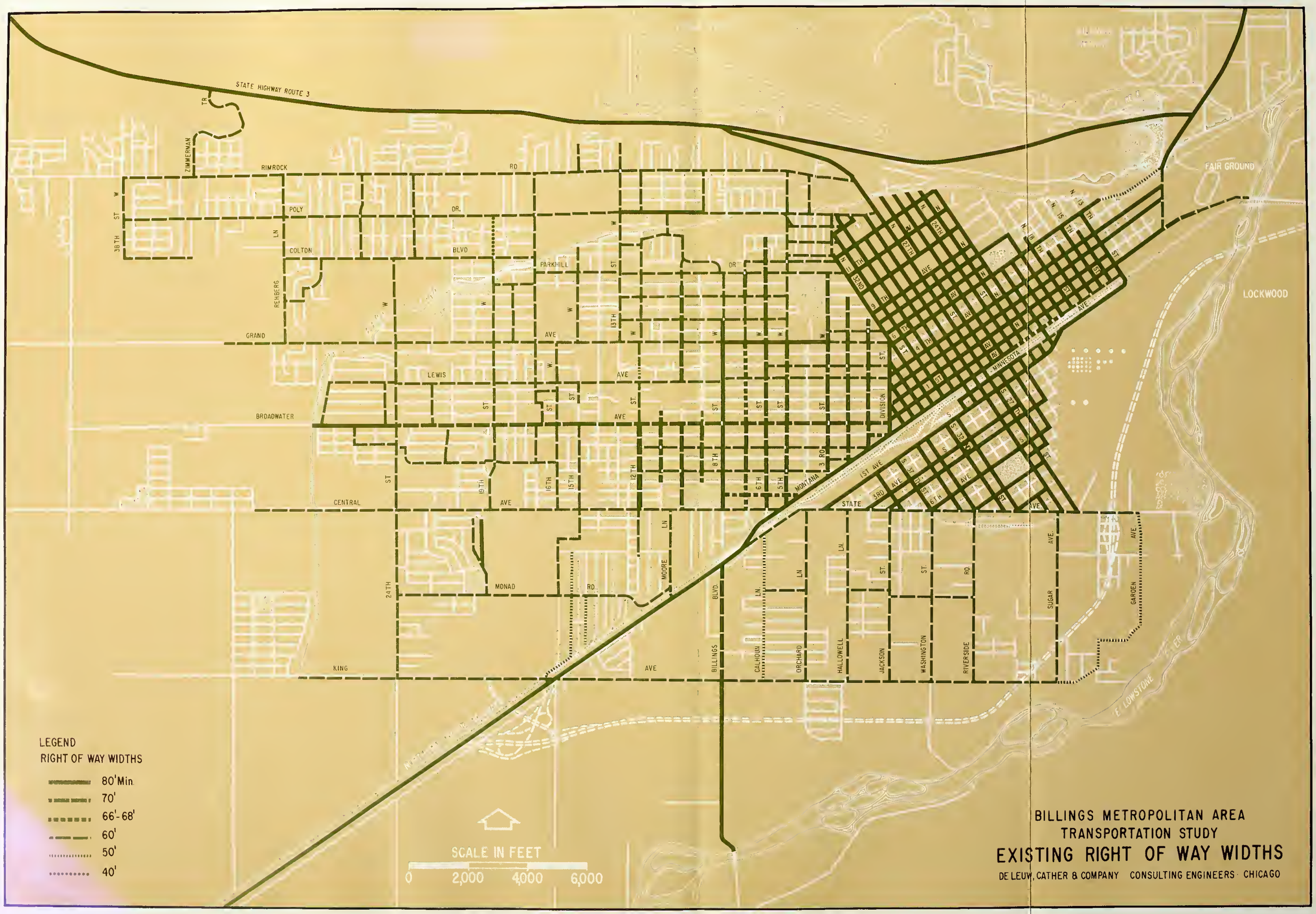

STATE HIGHWAY ROUTE 3
ZIMMERMAN TR.
RIMROCK RD
POLY DR.
COLTON BLVD
PARKHILL DR
GRAND AVE
LEWIS AVE
BROADWATER AVE
CENTRAL AVE
MONAD RD.
KING AVE
38TH ST W
REHBERG LN
24TH ST
19TH ST
16TH ST
15TH ST
13TH ST W
12TH ST
8TH ST
6TH ST
5TH ST
3 RD
MONTANA
STATE
DIVISION ST
BILLINGS BLVD.
MOORE LN
CALHOUN LN.
ORCHARD LN
HALLOWELL LN.
JACKSON ST.
WASHINGTON ST.
RIVERSIDE RD.
SUGAR AVE.
GARDEN AVE.
1ST AVE
3RD AVE
6TH AVE
24TH AVE
MINNESOTA AVE
N 24TH ST
N 27TH ST
N 13TH ST
N 15TH ST
N 16TH ST
N 3RD ST
N 6TH ST
N 4TH ST
N 1ST ST
S 37TH ST
S 34TH ST
S 6TH ST
S 3RD ST
FAIR GROUND
LOCKWOOD
E. YELLOWSTONE RIVER
NORTHERN PACIFIC
LEGEND
RIGHT OF WAY WIDTHS
80' Min.
70'
66'-68'
60'
50'
40'
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
EXISTING RIGHT OF WAY WIDTHS
DE LEUW, CATHER & COMPANY CONSULTING ENGINEERS CHICAGO

EXHIBIT 7

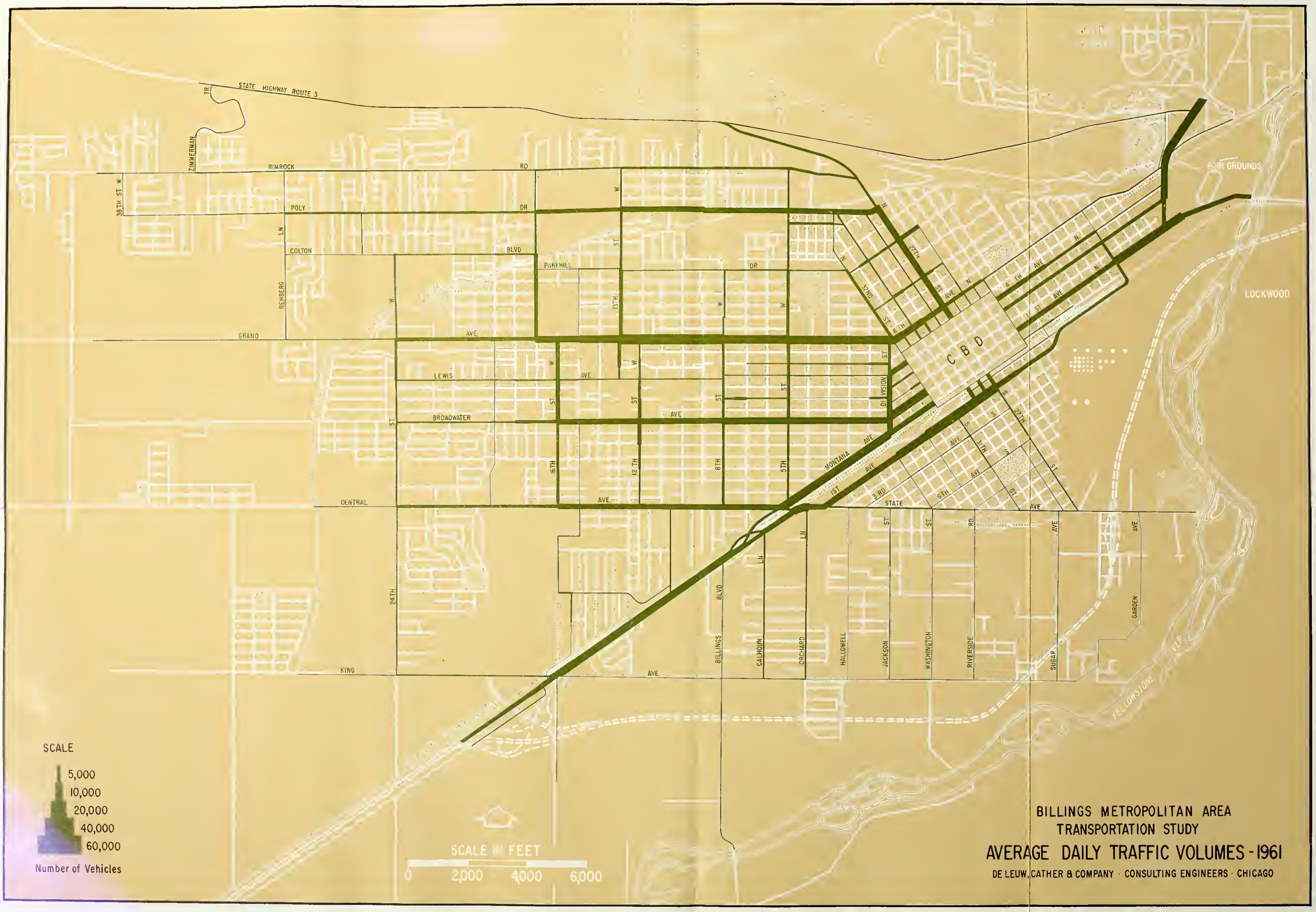
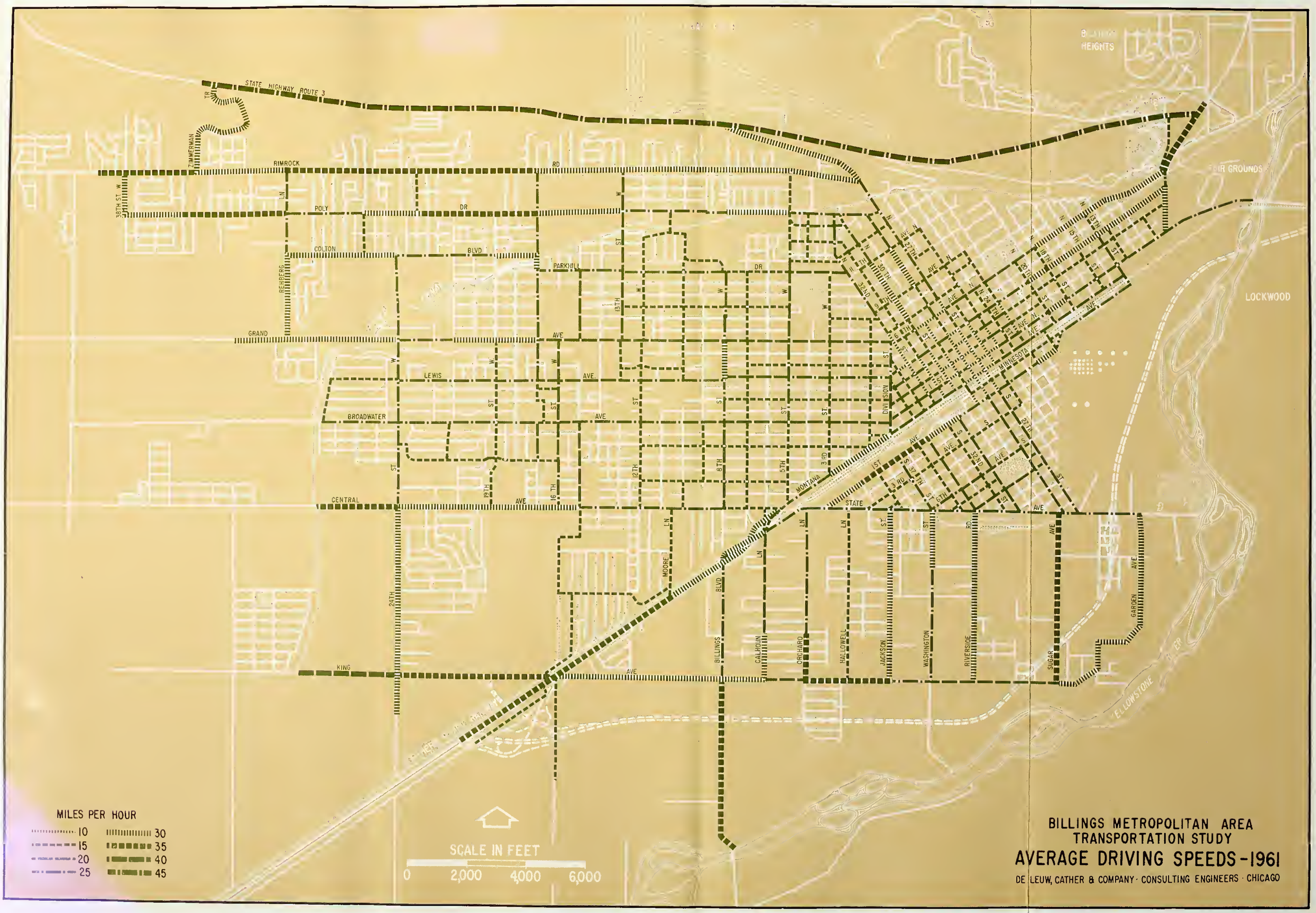

STATE HIGHWAY ROUTE 3
TR.
ZIMMERMAN
RIMROCK
RD
38TH ST W
POLY
DR.
LN
COLTON
BLVD
REHBERG
PARKHILL
DR
13TH
ST
W
GRANO
AVE
LEWIS
AVE
BROADWATER
AVE
16TH
12 TH
8TH
5TH
CENTRAL
AVE
24TH
KING
AVE
BILLINGS
BLVD
CALHOUN
LN
ORCHARD
LN
HALLOWELL
JACKSON
ST
WASHINGTON
ST
RIVERSIDE
RD
SUGAR
AVE
GARDEN
AVE
MONTANA
AVE
1ST
AVE
3 RD
STATE
AVE
5TH
AVE
31TH
AVE
27TH
ST
S
32ND
ST
6TH
ST
27TH
ST
AVE
N
4 TH
AVE
N
ST
AVE
N
DIVISION
ST
C B D
FAIR GROUNDS
LOCKWOOD
YELLOWSTONE
RIVER
SCALE
5,000
10,000
20,000
40,000
60,000
Number of Vehicles
SCALE IN FEET
0
2,000
4000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
AVERAGE DAILY TRAFFIC VOLUMES - 1961
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 8


STATE HIGHWAY ROUTE 3
RIMROCK
RD
POLY
DR
COLTON
BLVD
PARKHILL
DR
GRAND
AVE
LEWIS
AVE.
BROADWATER
AVE
CENTRAL
AVE
KING
AVE
38TH ST. W.
ZIMMERMAN
TR
REHBERG
LN
W
ST
13TH
19TH
16 TH
12TH
8TH
5TH
3RD
MONTANA
STATE
MOORE
BILLINGS
BLVD
CALHOUN
ORCHARD
HALLOWELL
JACKSON
WASHINGTON
RIVERSIDE
SUGAR
GARDEN
24TH
DIVISION
MINNESOTA
LOCKWOOD
FAIR GROUNDS
HEIGHTS
YELLOWSTONE RIVER
MILES PER HOUR
10
15
20
25
30
35
40
45
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
AVERAGE DRIVING SPEEDS-1961
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

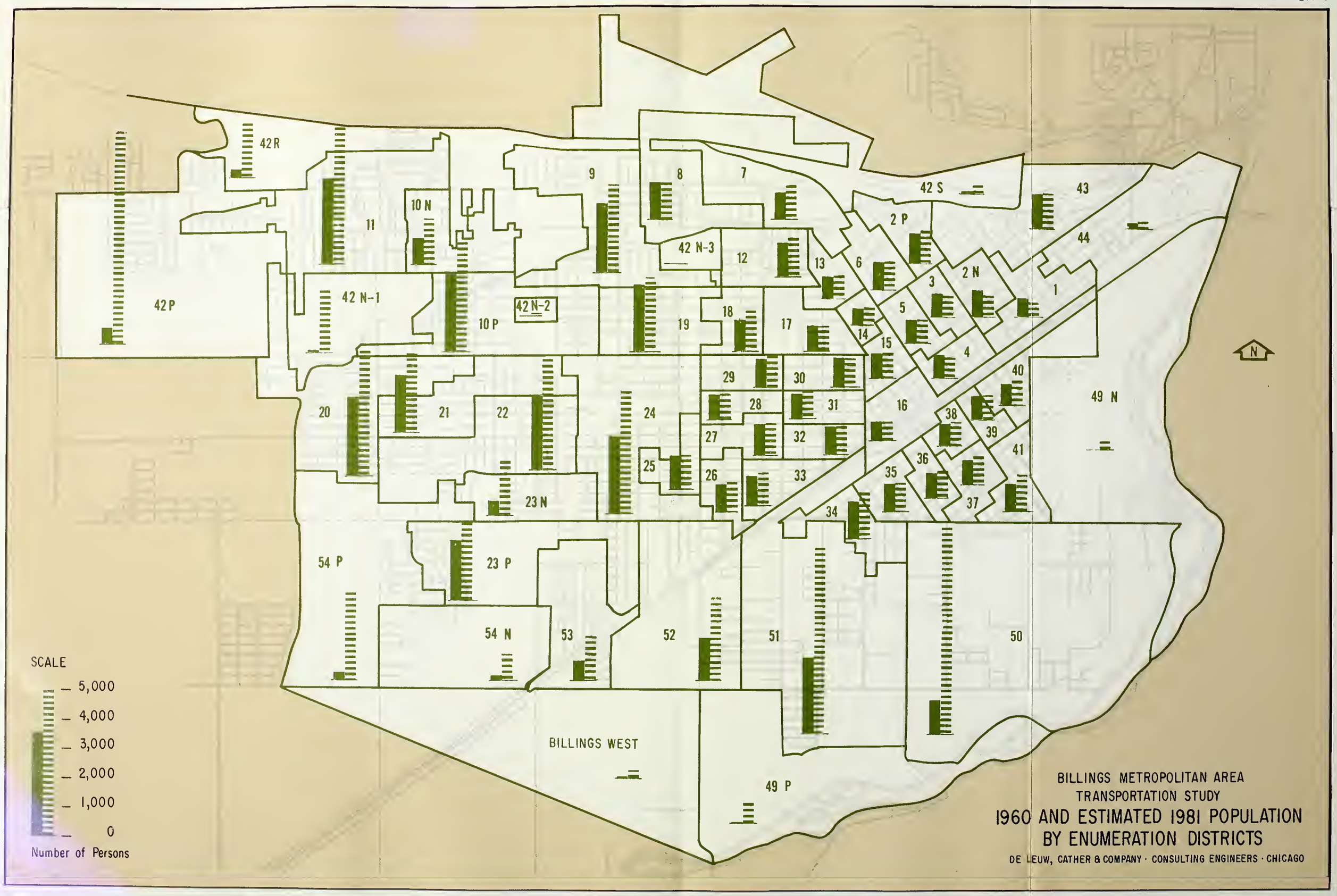
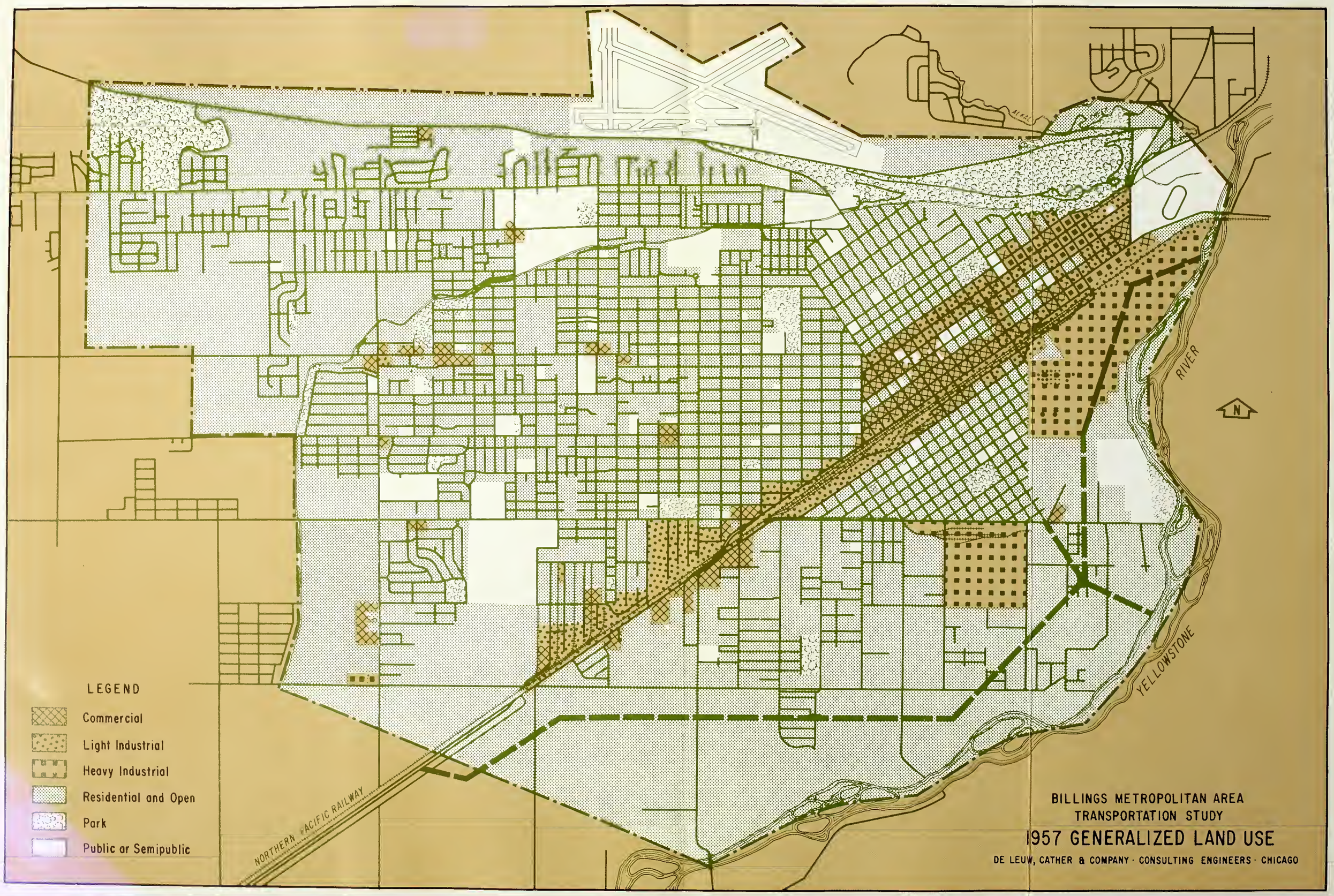
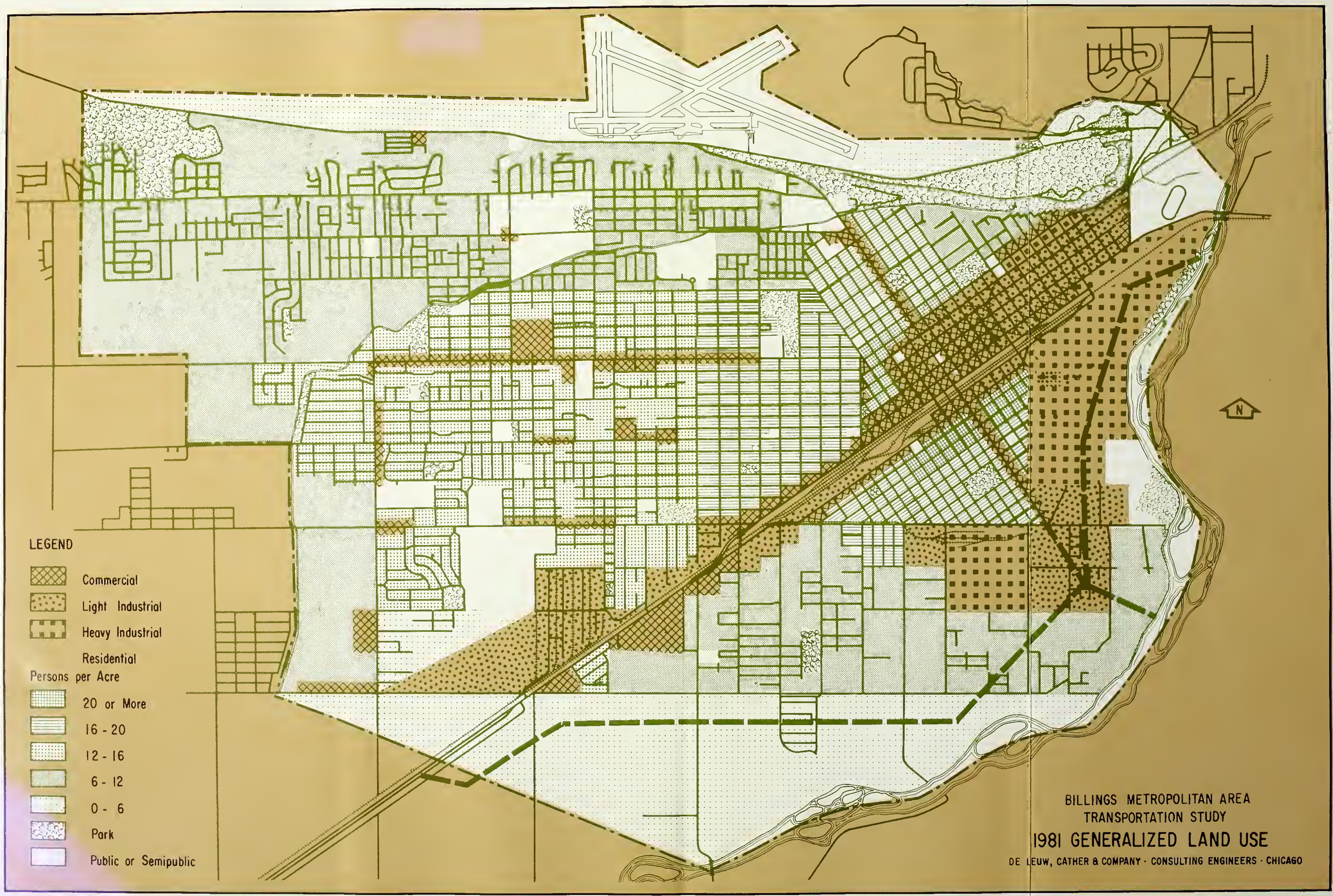

42 R
42 P
42 N-1
10 N
11
10 P
42 N-2
9
8
7
42 N-3
12
13
6
2 P
42 S
43
44
2 N
3
5
1
14
15
4
18
19
17
29
30
28
31
27
32
26
33
25
24
16
38
39
40
41
36
35
37
34
49 N
20
21
22
23 N
54 P
23 P
54 N
53
52
51
50
49 P
BILLINGS WEST
N
SCALE
5,000
4,000
3,000
2,000
1,000
0
Number of Persons
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
1960 AND ESTIMATED 1981 POPULATION
BY ENUMERATION DISTRICTS
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 10


LEGEND
Commercial
Light Industrial
Heavy Industrial
Residential and Open
Park
Public or Semipublic
NORTHERN PACIFIC RAILWAY
YELLOWSTONE
RIVER
N
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
1957 GENERALIZED LAND USE
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


LEGEND
Commercial
Light Industrial
Heavy Industrial
Residential
Persons per Acre
20 or More
16 - 20
12 - 16
6 - 12
0 - 6
Park
Public or Semipublic
N
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
1981 GENERALIZED LAND USE
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

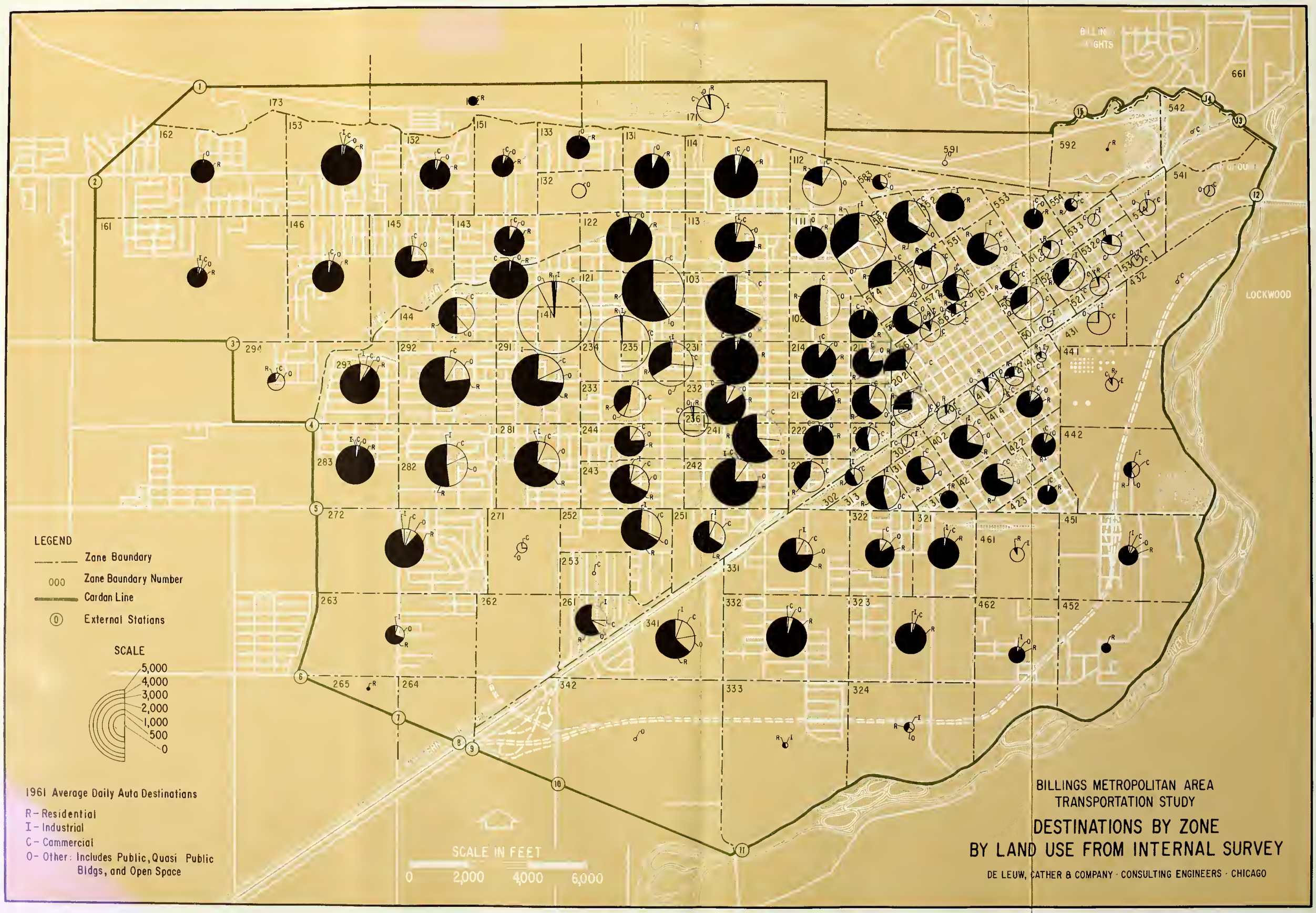
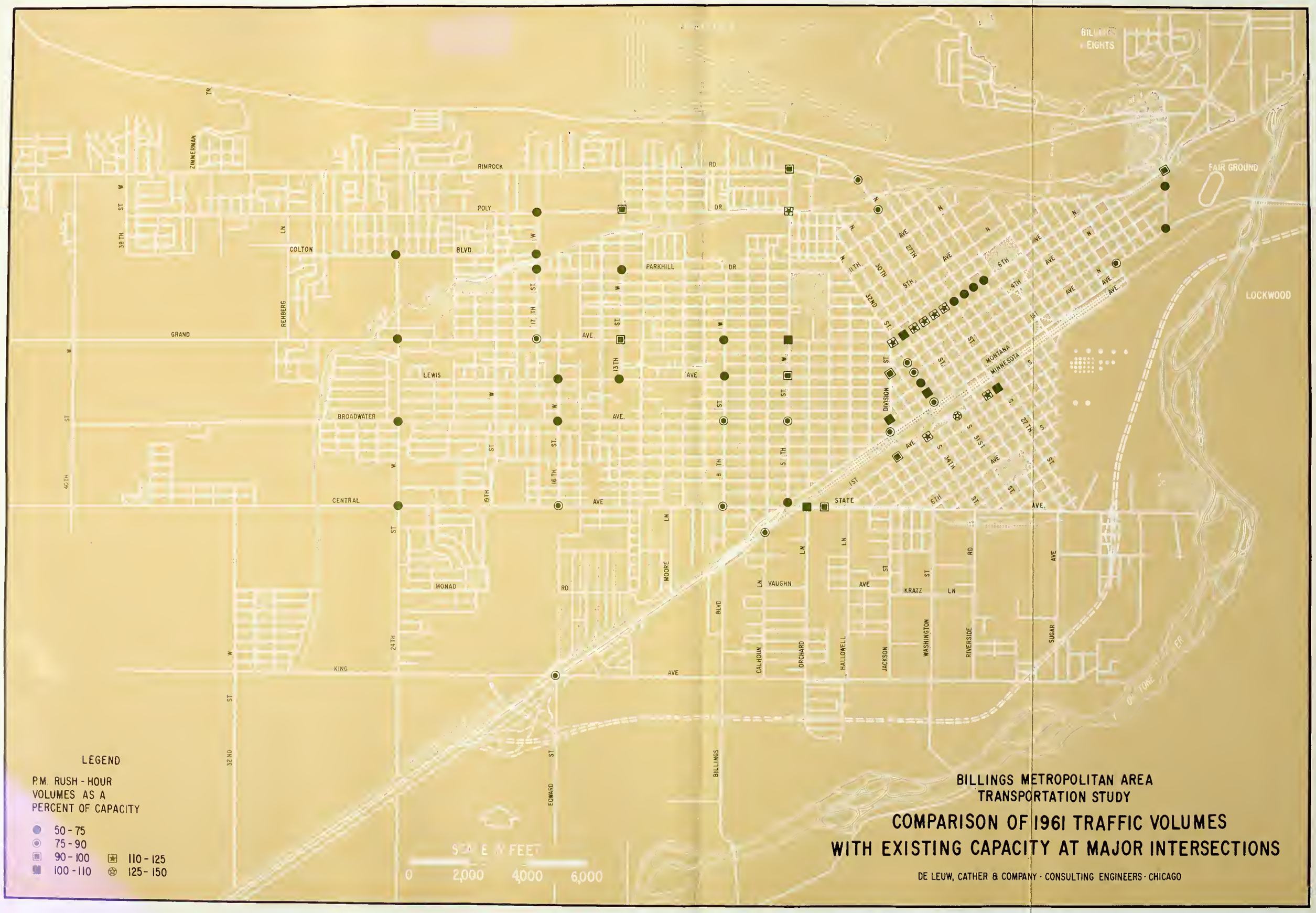

LEGEND
Zone Boundary
000 Zone Boundary Number
Cordon Line
External Stations
SCALE
5,000
4,000
3,000
2,000
1,000
500
0
1961 Average Daily Auto Destinations
R - Residential
I - Industrial
C - Commercial
O - Other: Includes Public, Quasi Public Bldgs, and Open Space
SCALE IN FEET
0 2,000 4,000 6,000
LOCKWOOD
BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY
DESTINATIONS BY ZONE BY LAND USE FROM INTERNAL SURVEY
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 13

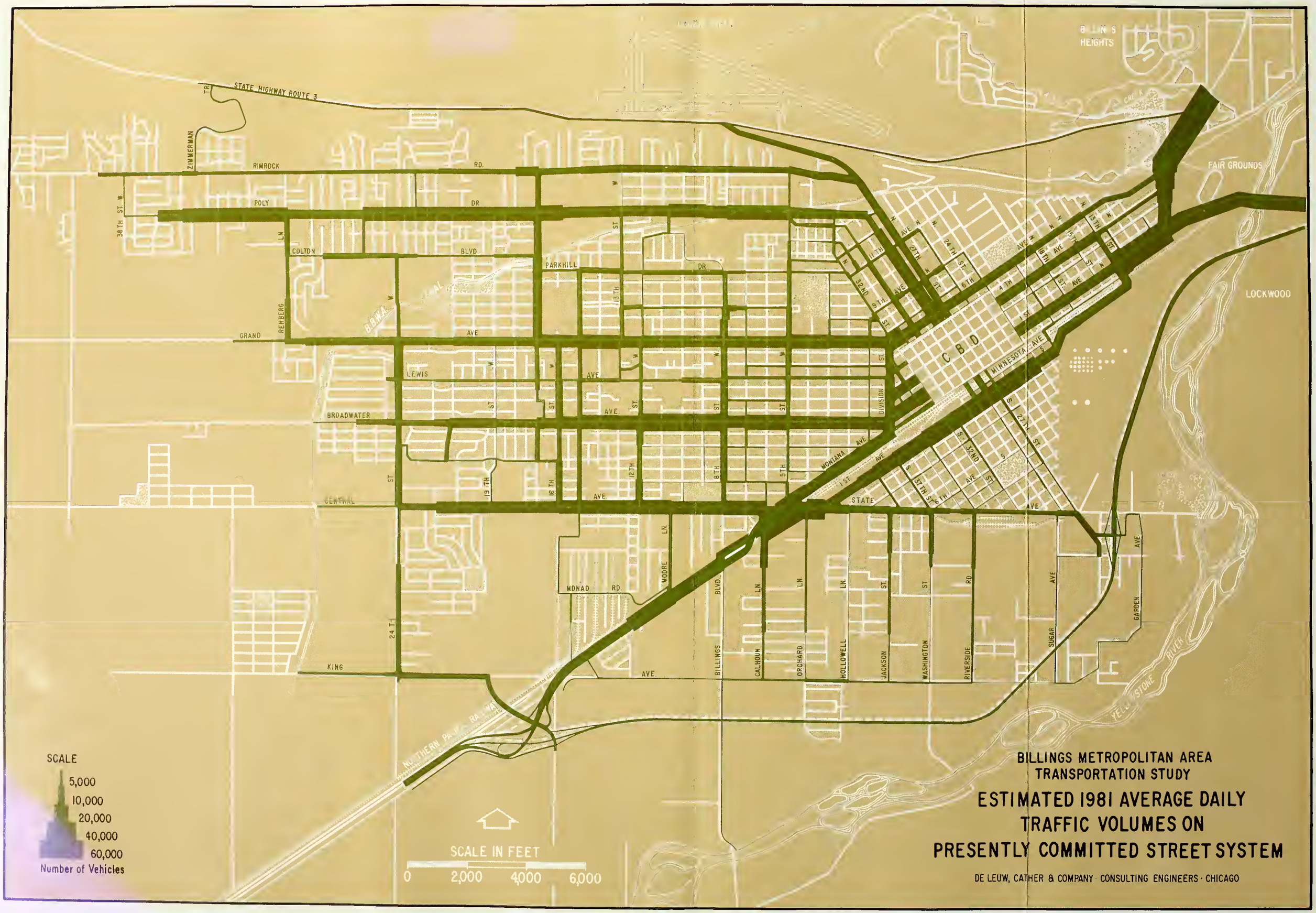


BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY

COMPARISON OF 1961 TRAFFIC VOLUMES WITH EXISTING CAPACITY AT MAJOR INTERSECTIONS

DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 14



BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

ESTIMATED 1981 AVERAGE DAILY
TRAFFIC VOLUMES ON
PRESENTLY COMMITTED STREET SYSTEM

DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 15

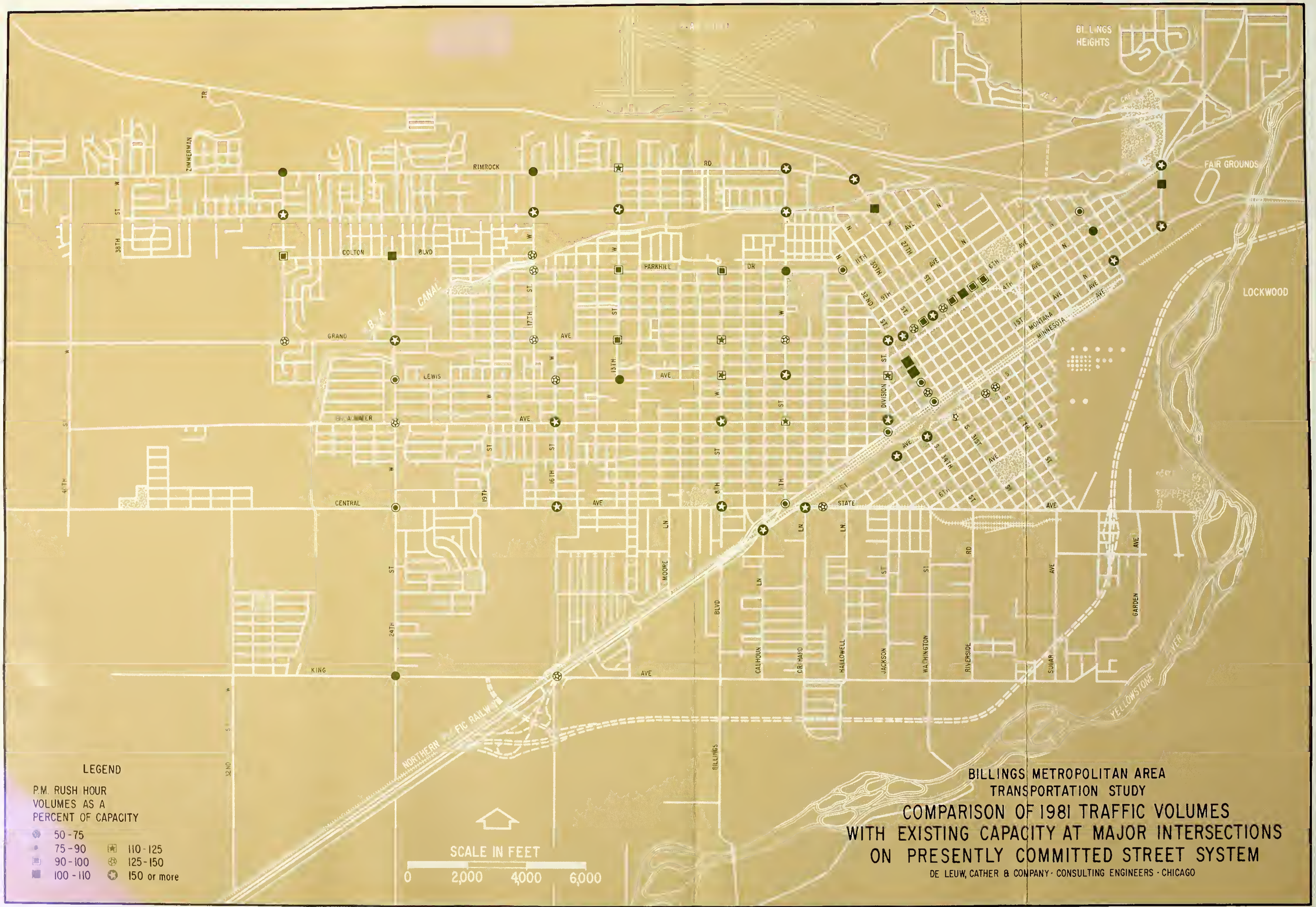

BILLINGS HEIGHTS
FAIR GROUNDS
LOCKWOOD
RIMROCK RD
COLTON BLVD
PARKHILL DR
GRAND AVE
LEWIS AVE
BROADWATER AVE
CENTRAL AVE
STATE AVE
KING AVE
ZIMMERMAN TR
38TH ST W
41TH ST
24TH ST W
32ND ST W
17TH ST W
15TH ST W
16TH ST W
19TH ST W
8TH ST W
7TH ST W
MOORE LN
BLVD
CALHOUN LN
ORCHARD LN
HALLOWELL LN
JACKSON ST
WASHINGTON ST
RIVERSIDE RD
SUGAR AVE
GARDEN AVE
DIVISION ST
11TH ST N
30TH ST N
32ND ST N
27TH AVE N
6TH AVE N
4TH AVE N
1ST AVE N
MONTANA AVE
MINNESOTA AVE
S 34TH ST
S 35TH ST
6TH ST S
2ND ST S
BILLINGS
B.A. CANAL
NORTHERN PACIFIC RAILWAY
YELLOWSTONE RIVER
LEGEND
P.M. RUSH HOUR VOLUMES AS A PERCENT OF CAPACITY
50-75
75-90
90-100
100-110
110-125
125-150
150 or more
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
COMPARISON OF 1981 TRAFFIC VOLUMES
WITH EXISTING CAPACITY AT MAJOR INTERSECTIONS
ON PRESENTLY COMMITTED STREET SYSTEM
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 16

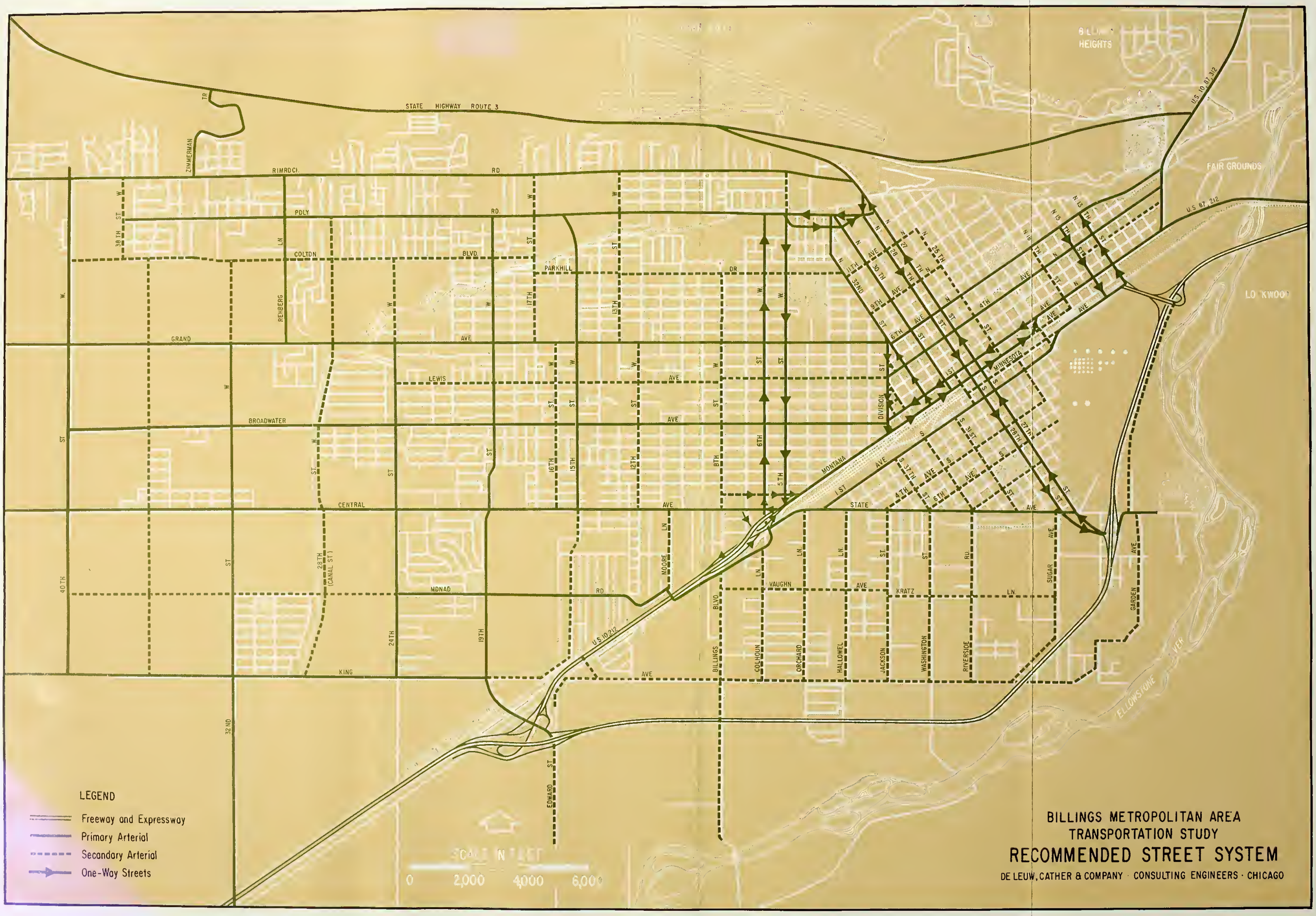
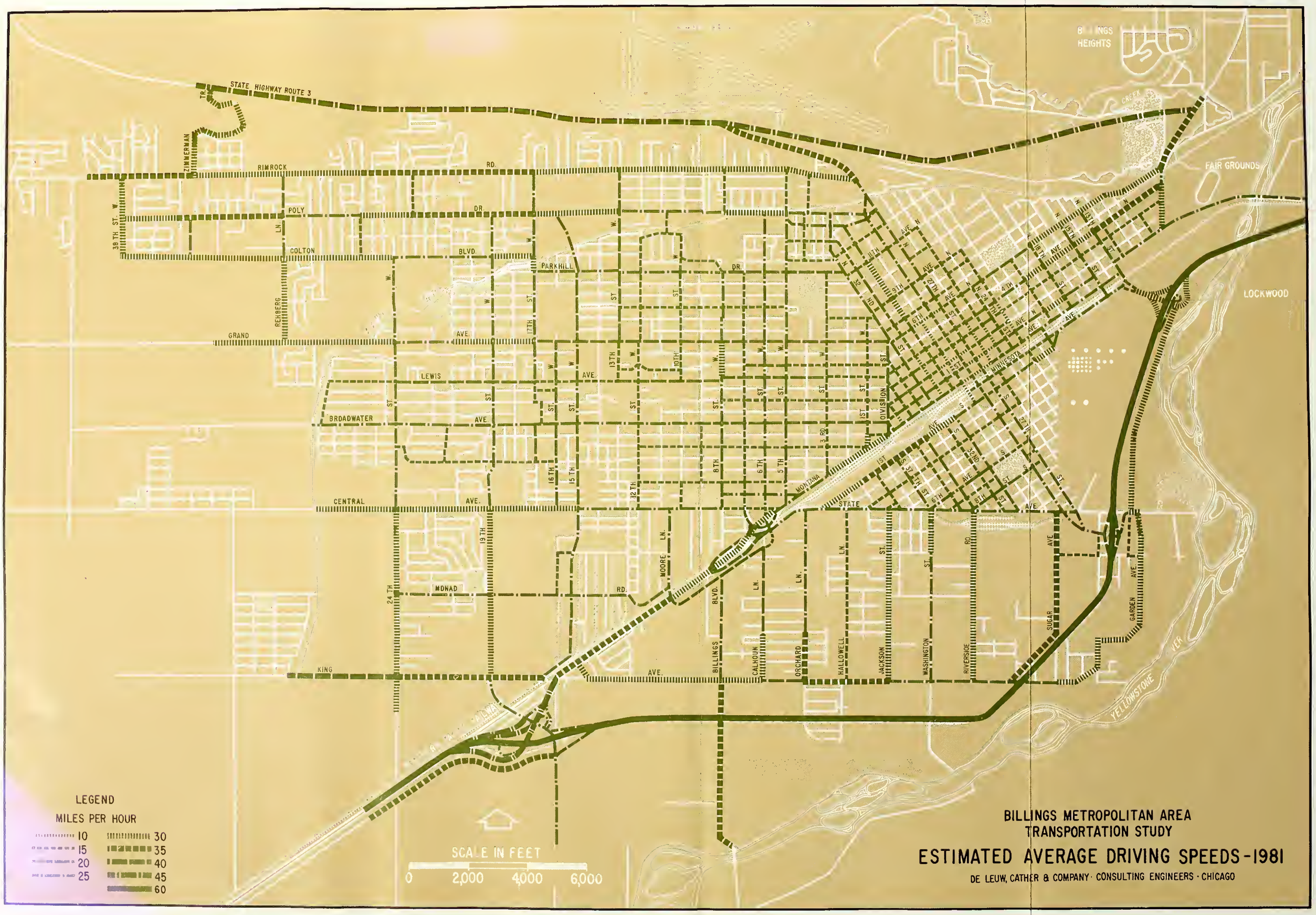

BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED STREET SYSTEM
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO
LEGEND
Freeway and Expressway
Primary Arterial
Secondary Arterial
One-Way Streets
SCALE IN FEET
0
2,000
4,000
6,000
STATE HIGHWAY ROUTE 3
RIMROCK RD
POLY RD
COLTON BLVD
PARKHILL DR
GRAND AVE
LEWIS AVE
BROADWATER AVE
CENTRAL AVE
MONAD RD
KING AVE
MONTANA
I ST
STATE AVE
DIVISION
MINNESOTA
VAUGHN AVE
KRATZ LN
U.S. 10, 87, 312
U.S. 10 212
FAIR GROUNDS
LOCKWOOD
YELLOWSTONE
ZIMMERMAN TR
38TH ST W
REHBERG LN
17TH ST W
13TH ST W
28TH (CANAL ST)
24TH ST
19TH ST
16TH ST
15TH ST
12TH ST
8TH ST
5TH ST
MOORE LN
BILLINGS BLVD
COLHOUN LN
ORCHARD LN
HALLOWEL LN
JACKSON ST
WASHINGTON ST
RIVERSIDE RD
SUGAR AVE
GARDEN AVE
EDWARD ST
32ND ST
40TH ST
N 32ND ST
N 30TH ST
N 28TH ST
N 27TH ST
N 25TH ST
N 15TH ST
N 13TH ST
N 1ST AVE
N 4TH AVE
N 6TH AVE
S 1ST ST
S 3RD ST
S 4TH ST
S 6TH ST
S 27TH ST
S 28TH ST
S 37TH ST

EXHIBIT 17


STATE HIGHWAY ROUTE 3
RIMROCK
RD.
POLY
DR.
COLTON
BLVD.
PARKHILL
DR.
GRAND
AVE.
LEWIS
AVE.
BROADWATER
AVE.
CENTRAL
AVE.
MONAD
RD.
KING
AVE.
38 TH ST. W.
ZIMMERMAN
TR.
REHBERG
LN.
17TH
13TH
10TH
16TH
15TH
12TH
8TH
6TH
5TH
3RD
24 TH
19 TH
MOORE
LN.
BLVD.
BILLINGS
CALHOUN
LN.
ORCHARD
LN.
HALLOWELL
LN.
JACKSON
ST.
WASHINGTON
ST.
RIVERSIDE
RD.
SUGAR
AVE.
GARDEN
AVE.
DIVISION
ST.
MONTANA
STATE
AVE.
MINNESOTA
AVE.
FAIR GROUNDS
LOCKWOOD
YELLOWSTONE
RIVER
BILLINGS
HEIGHTS
CREEK
LEGEND
MILES PER HOUR
10
15
20
25
30
35
40
45
60
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
ESTIMATED AVERAGE DRIVING SPEEDS-1981
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

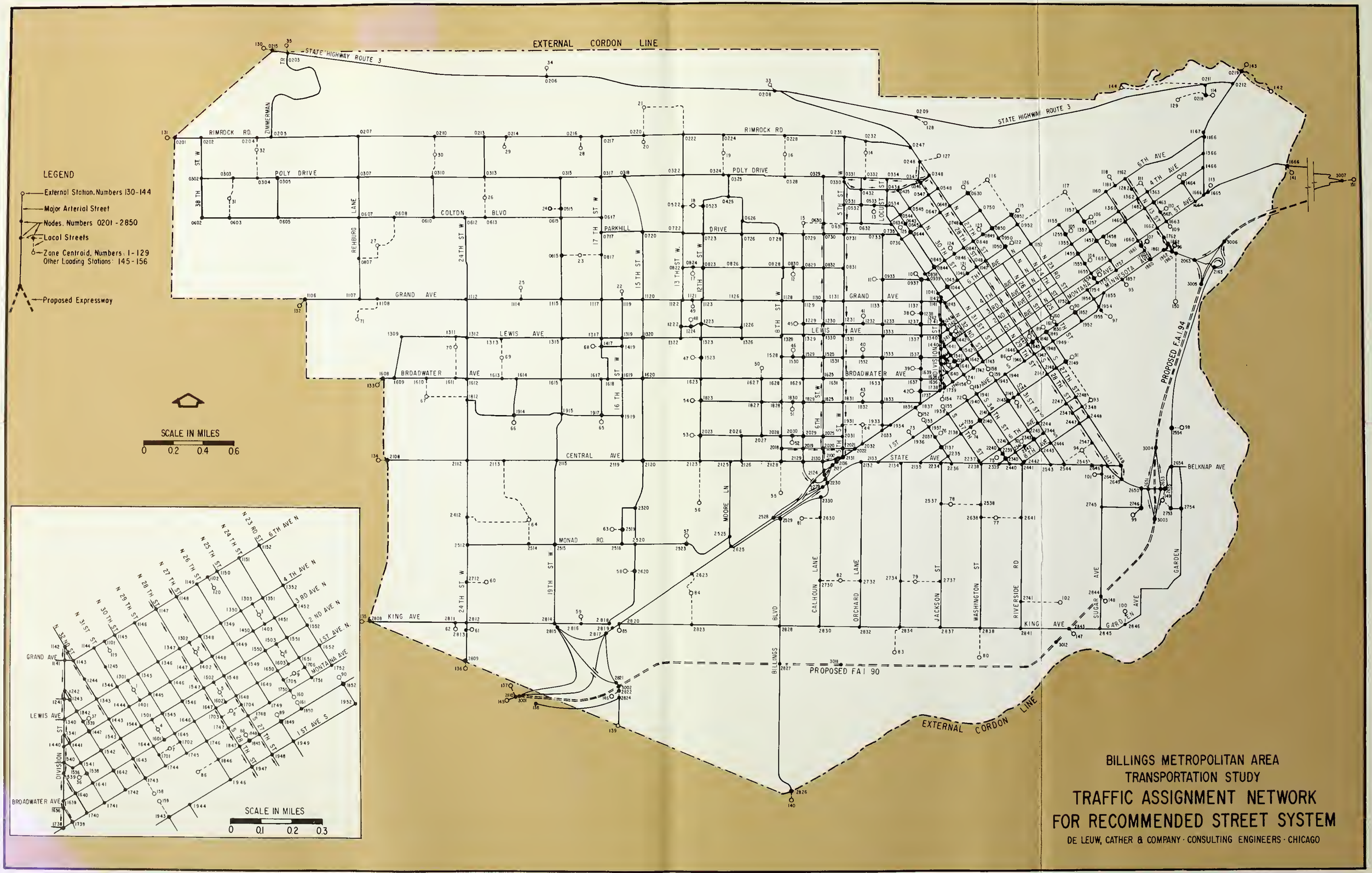
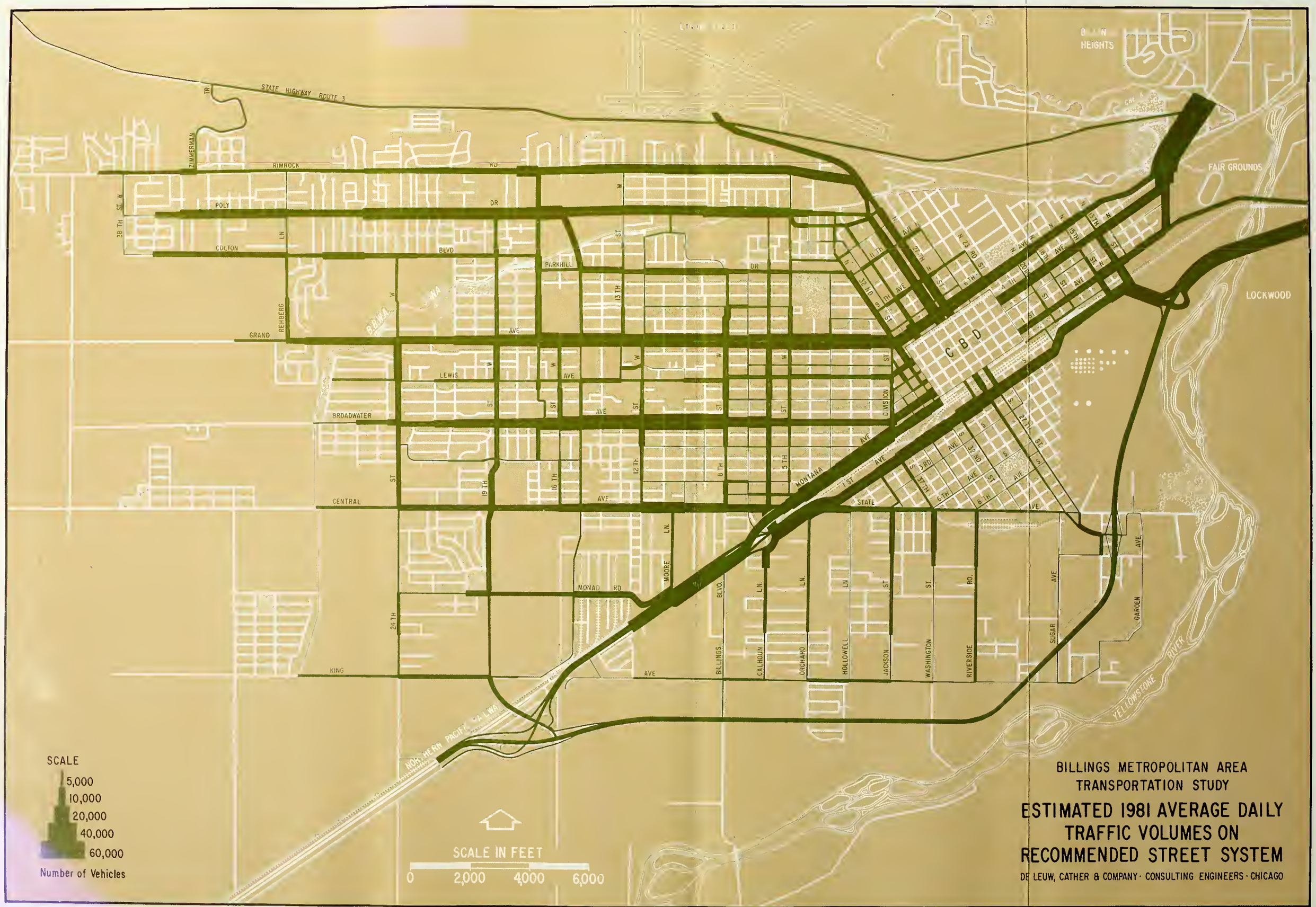
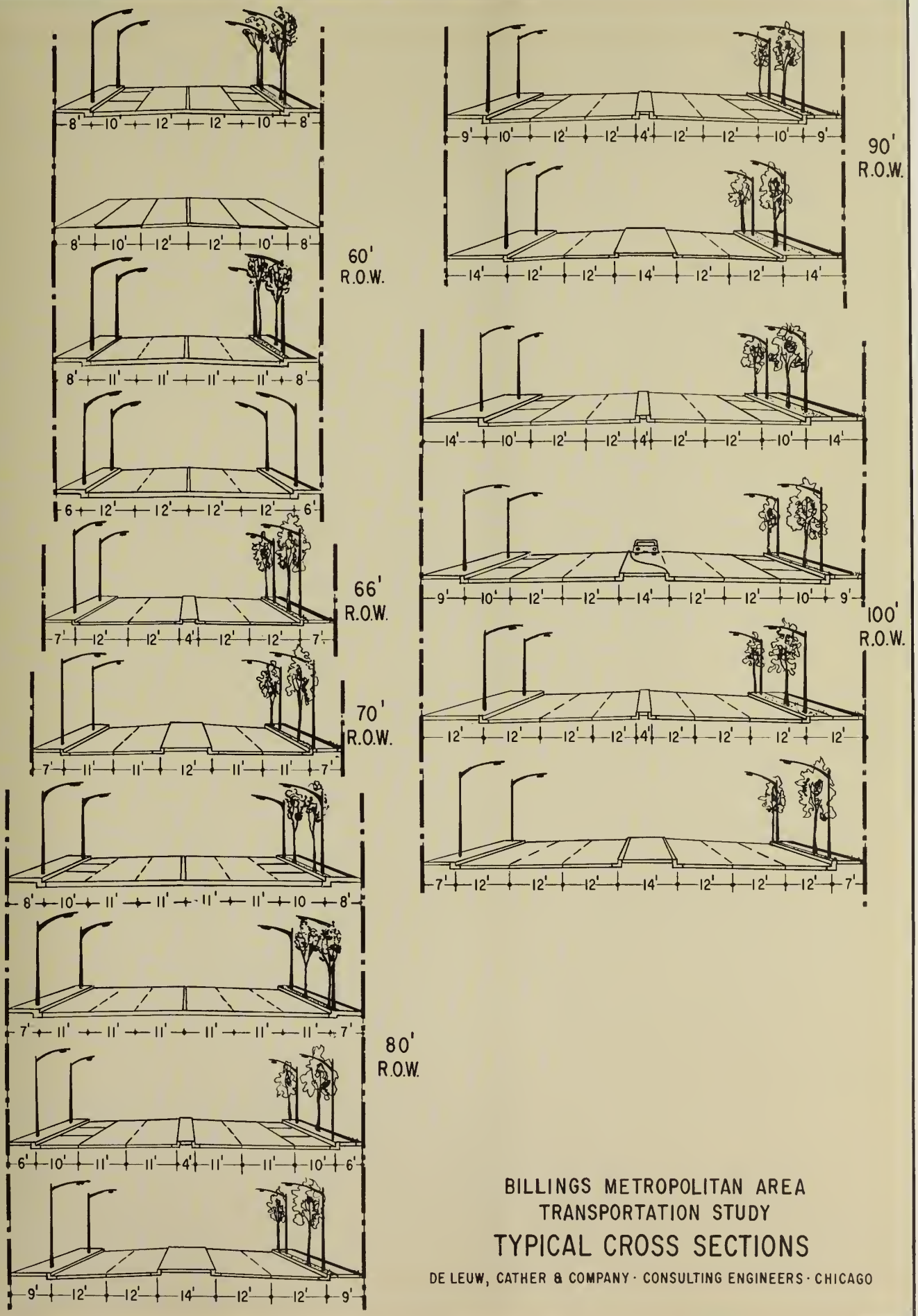

EXTERNAL CORDON LINE
STATE HIGHWAY ROUTE 3
LEGEND
External Station, Numbers 130-144
Major Arterial Street
Nodes, Numbers 0201 - 2850
Local Streets
Zone Centroid, Numbers: 1-129
Other Loading Stations: 145-156
Proposed Expressway
SCALE IN MILES
0 0.2 0.4 0.6
RIMROCK RD.
POLY DRIVE
COLTON BLVD
PARKHILL DRIVE
GRAND AVE
LEWIS AVE
BROADWATER AVE
CENTRAL AVE
MONAD RD.
KING AVE
STATE AVE
BELKNAP AVE
PROPOSED F.A.I. 94
PROPOSED FAI 90
SCALE IN MILES
0 0.1 0.2 0.3
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
TRAFFIC ASSIGNMENT NETWORK
FOR RECOMMENDED STREET SYSTEM
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 19

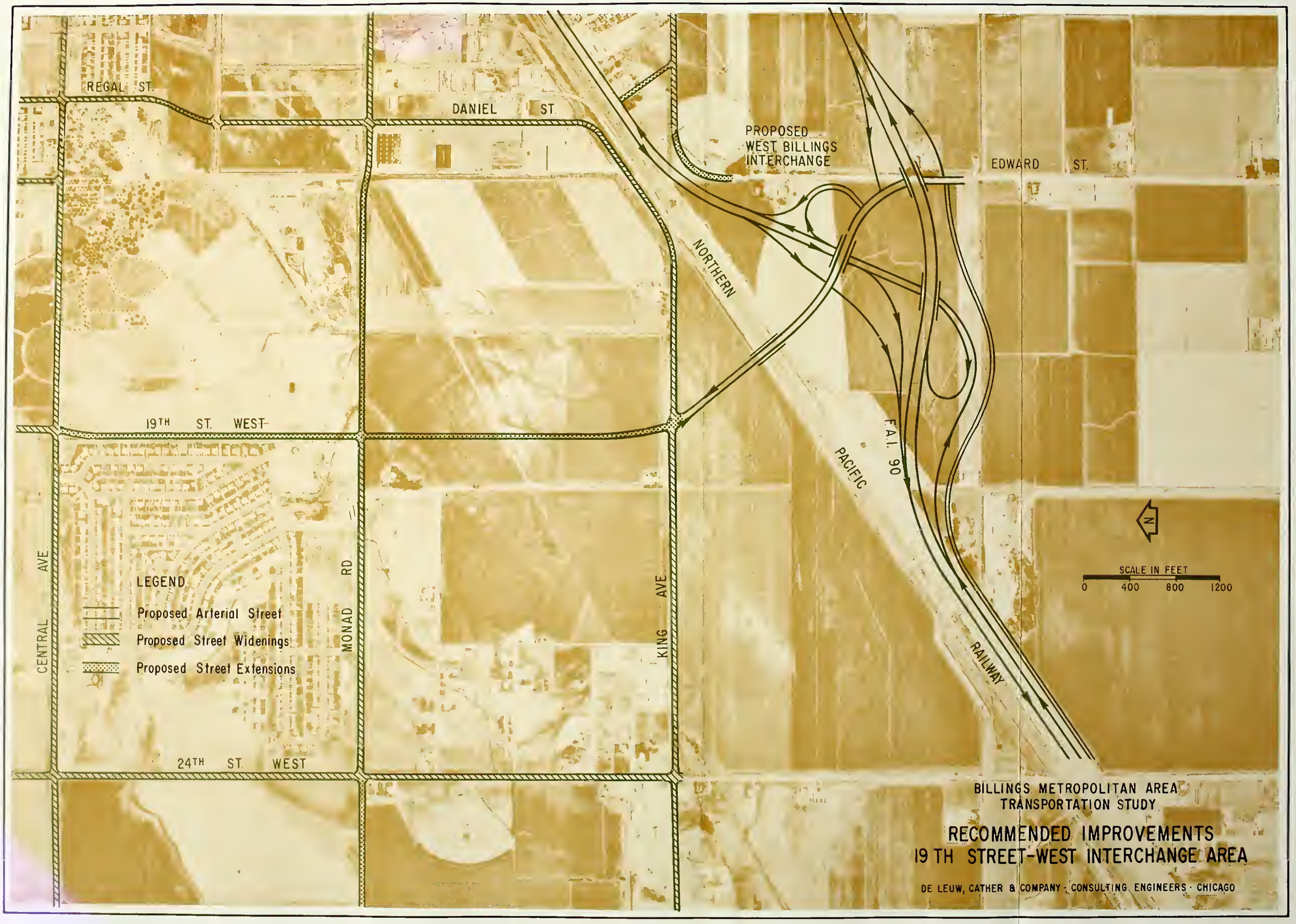

STATE HIGHWAY ROUTE 3
ZIMMERMAN TR.
RIMROCK RD
POLY DR
38 TH ST W
COLTON BLVD
LN
REHBERG
GRAND AVE
PARKHILL DR
13 TH ST
LEWIS AVE
BROADWATER AVE
CENTRAL AVE
KING AVE
24 TH ST
19 TH ST
16 TH ST
12 TH ST
8 TH ST
5 TH ST
DIVISION ST
MONTANA AVE
STATE AVE
MONAD RD.
MOORE LN.
BILLINGS BLVD.
CALHOUN LN.
ORCHARD LN.
HOLLOWELL LN.
JACKSON ST
WASHINGTON ST
RIVERSIDE RD.
SUGAR AVE
GARDEN AVE
C B D
FAIR GROUNDS
LOCKWOOD
HEIGHTS
YELLOWSTONE RIVER
NORTHERN PACIFIC RAILWAY
SCALE
5,000
10,000
20,000
40,000
60,000
Number of Vehicles
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
ESTIMATED 1981 AVERAGE DAILY
TRAFFIC VOLUMES ON
RECOMMENDED STREET SYSTEM
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

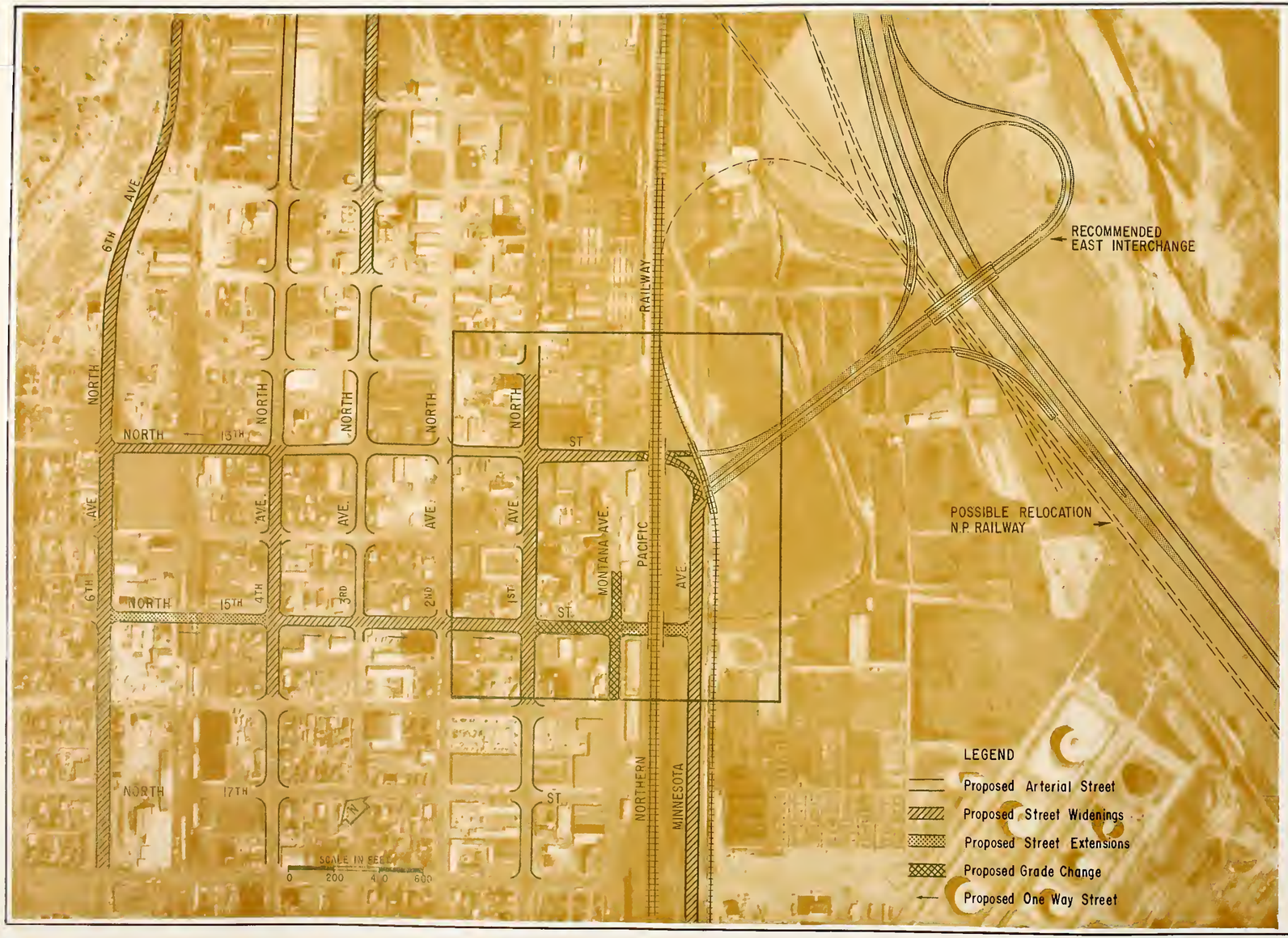


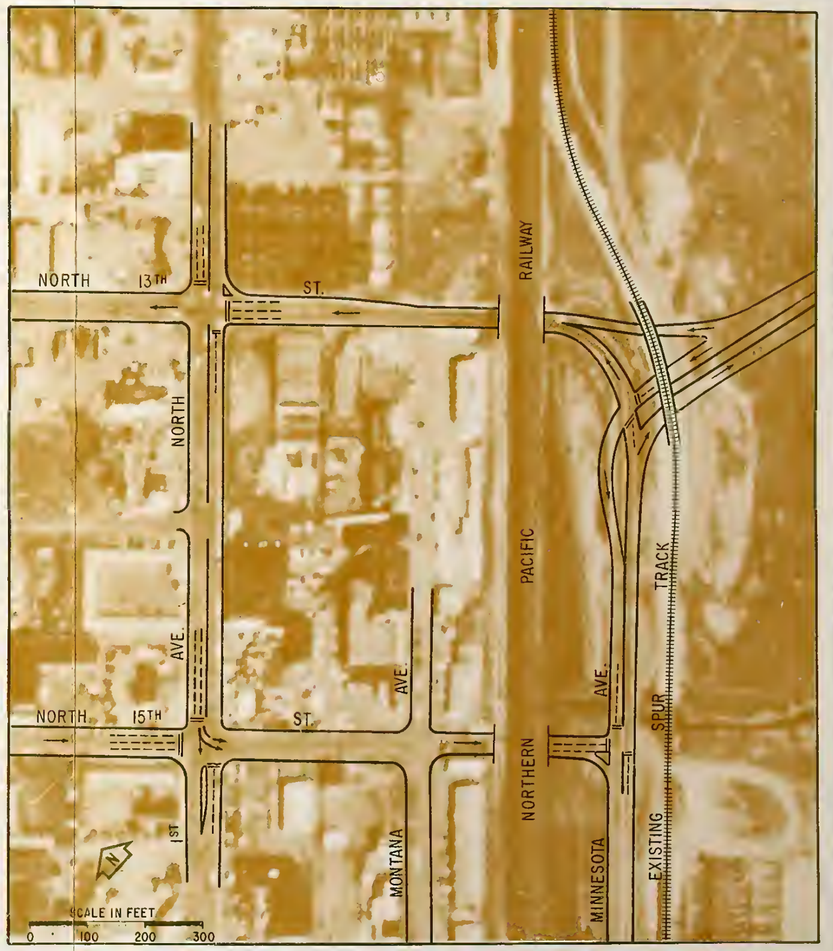
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

TYPICAL CROSS SECTIONS

DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


REGAL ST.
DANIEL ST.
PROPOSED
WEST BILLINGS
INTERCHANGE
EDWARD ST.
NORTHERN
PACIFIC
RAILWAY
F.A.I. 90
19TH ST. WEST
24TH ST. WEST
CENTRAL AVE.
MONAD RD.
KING AVE
LEGEND
Proposed Arterial Street
Proposed Street Widenings
Proposed Street Extensions
N
SCALE IN FEET
0 400 800 1200
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED IMPROVEMENTS
19 TH STREET-WEST INTERCHANGE AREA
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

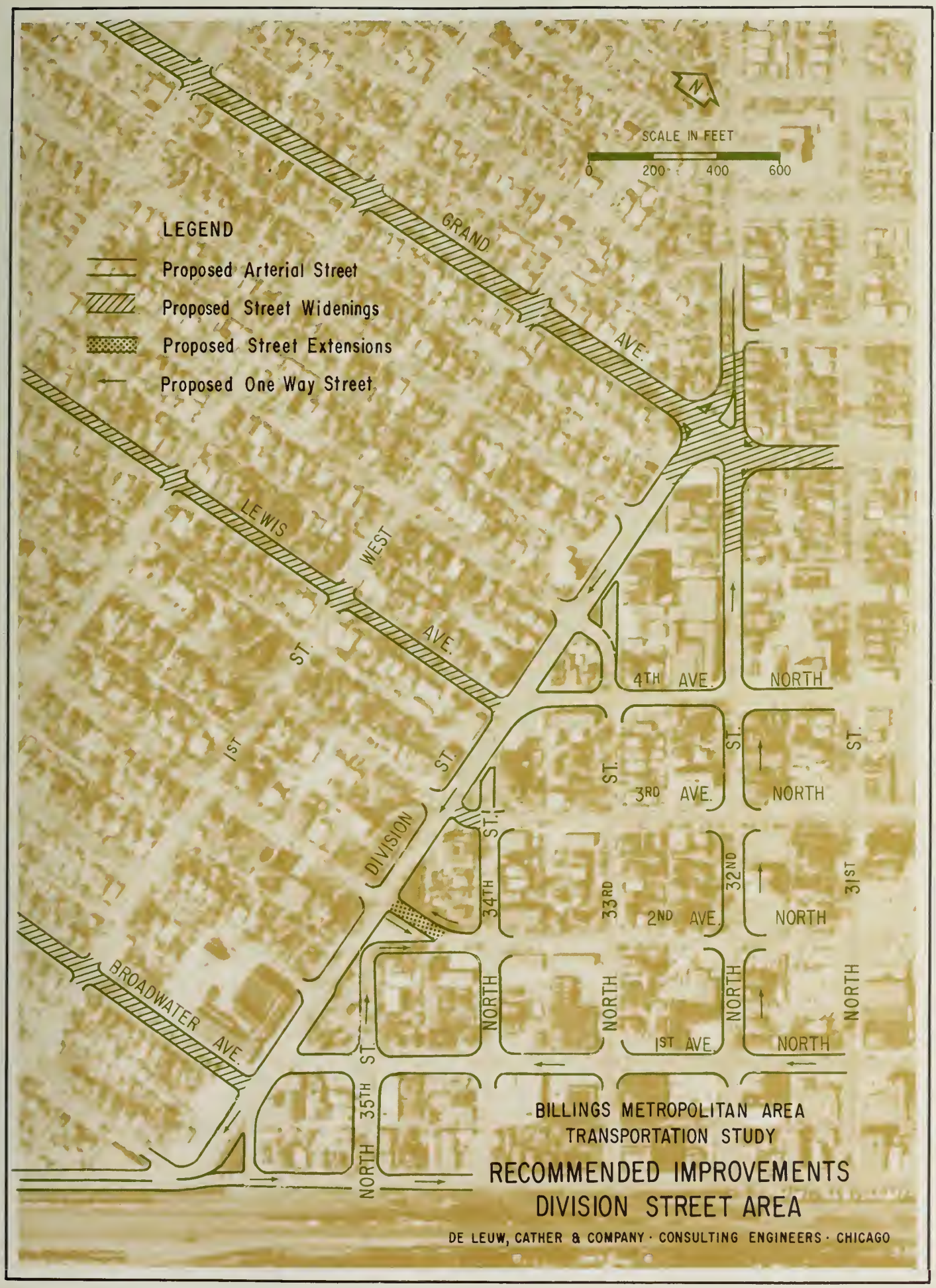


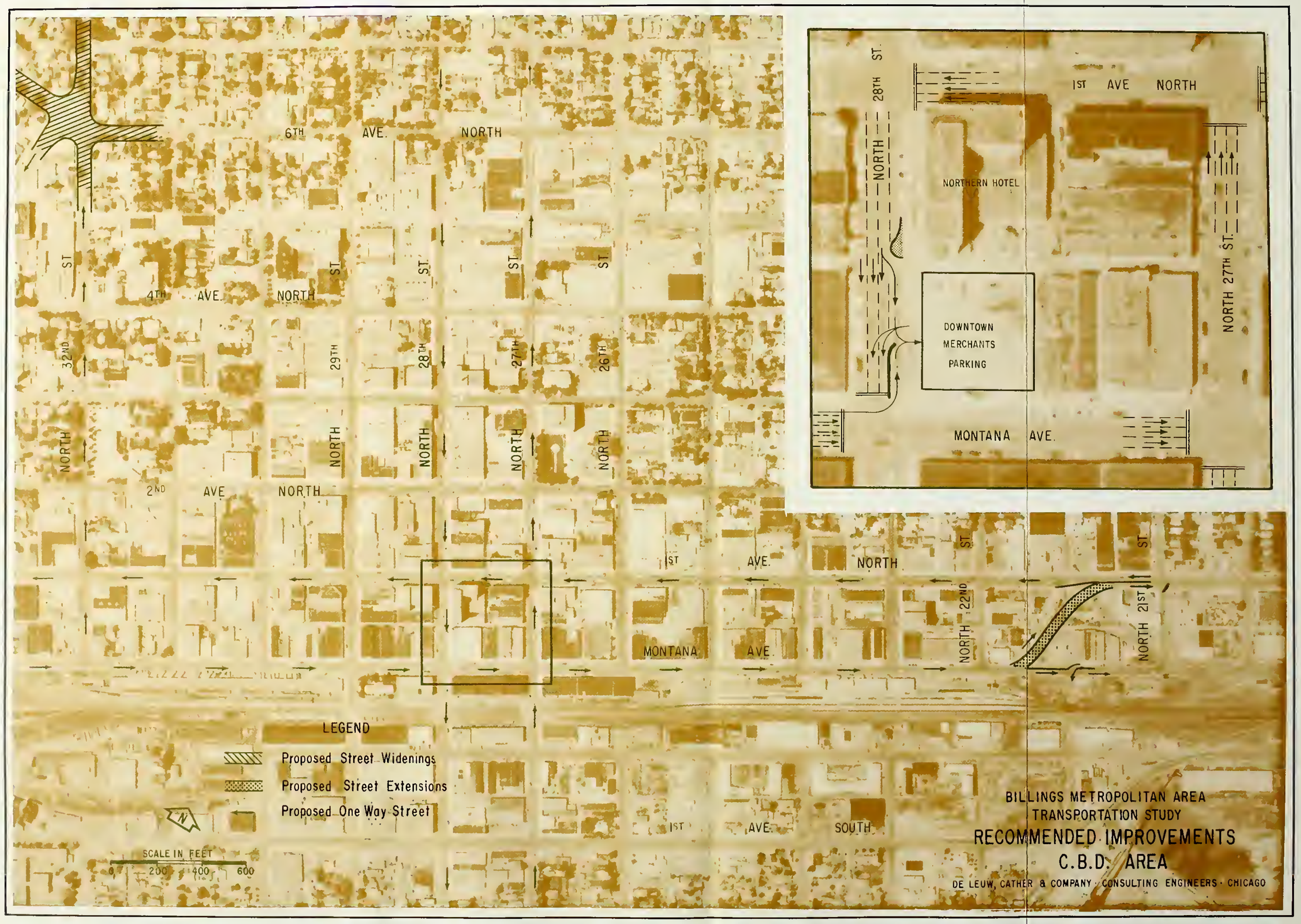


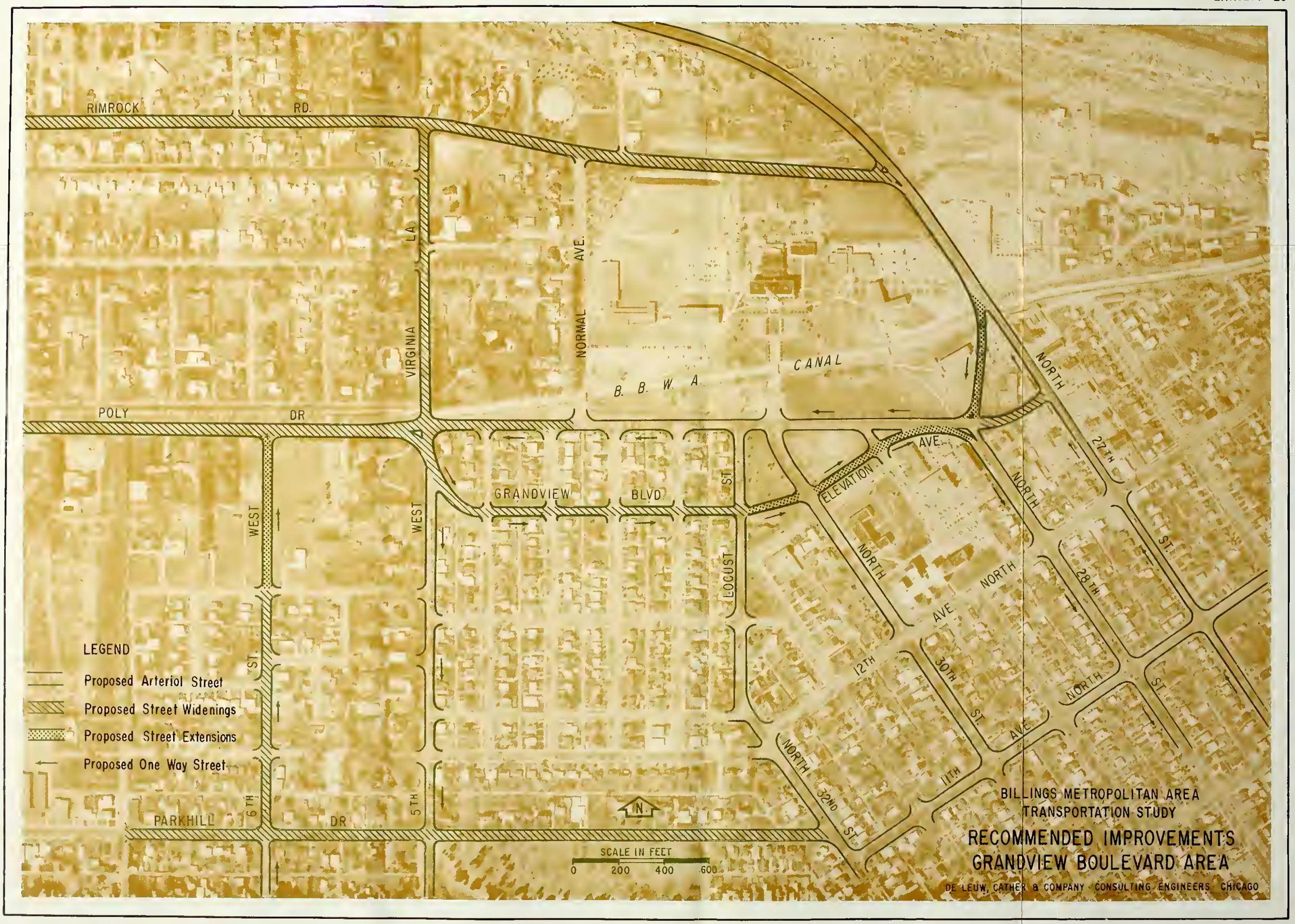
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

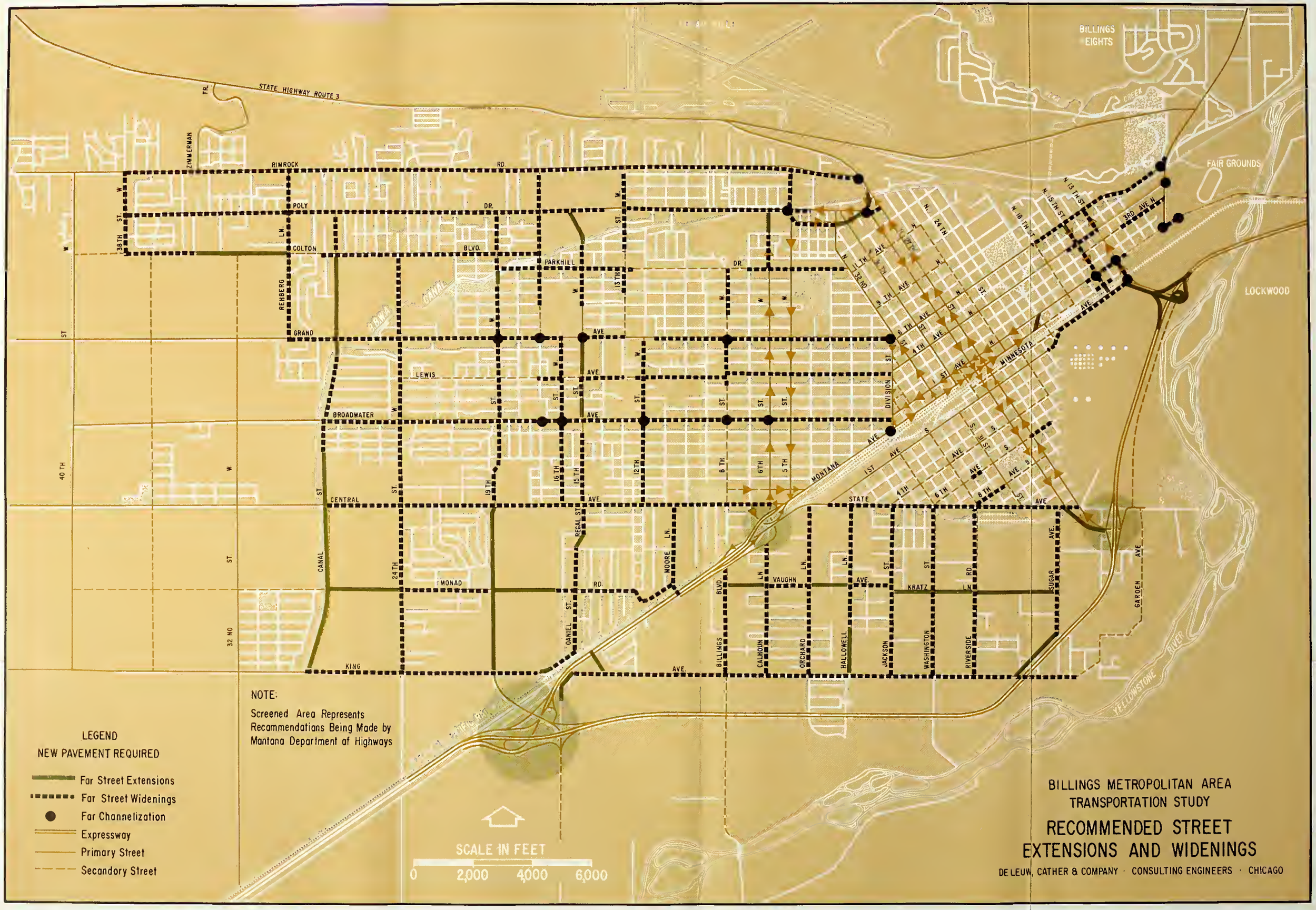
RECOMMENDED EAST INTERCHANGE AND NORTH 13TH–15TH STREET IMPROVEMENTS

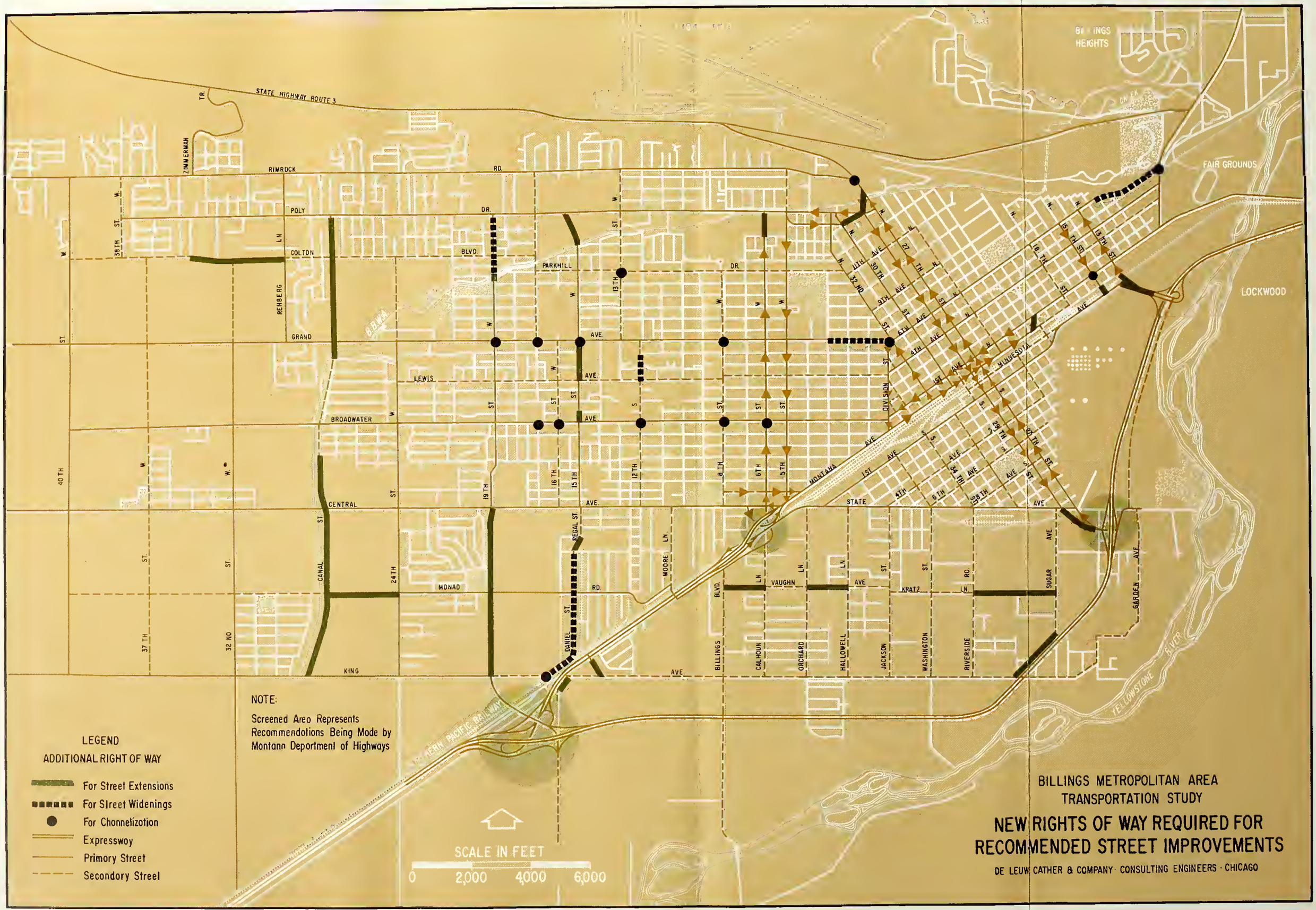
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


N
SCALE IN FEET
0
200
400
600
LEGEND
Proposed Arterial Street
Proposed Street Widenings
Proposed Street Extensions
Proposed One Way Street
GRAND AVE.
LEWIS AND CLARK AVE.
WEST
1ST ST.
DIVISION ST.
BROADWATER AVE.
4TH AVE. NORTH
3RD AVE. NORTH
2ND AVE. NORTH
1ST AVE. NORTH
34TH ST.
33RD ST.
32ND ST.
31ST ST.
35TH ST.
NORTH
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED IMPROVEMENTS
DIVISION STREET AREA
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


6TH AVE. NORTH
4TH AVE. NORTH
2ND AVE NORTH
32ND ST
NORTH ST
29TH NORTH ST
28TH NORTH ST
27TH NORTH ST
26TH NORTH ST
1ST AVE. NORTH
MONTANA AVE.
NORTH 22ND ST
NORTH 21ST ST
1ST AVE SOUTH
28TH ST. NORTH
1ST AVE NORTH
NORTHERN HOTEL
DOWNTOWN MERCHANTS PARKING
NORTH 27TH ST.
MONTANA AVE.
LEGEND
Proposed Street Widenings
Proposed Street Extensions
Proposed One Way Street
N
SCALE IN FEET
0 200 400 600
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED IMPROVEMENTS
C.B.D. AREA
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


RIMROCK RD.
POLY DR
VIRGINIA LA
NORMAL AVE.
B. B. W. A.
CANAL
NORTH 27TH
NORTH AVE.
ELEVATION
GRANDVIEW BLVD
WEST ST.
LOCUST ST.
NORTH 28TH ST.
NORTH AVE.
NORTH 30TH ST.
NORTH 12TH AVE.
NORTH 11TH
NORTH 32ND ST.
PARKHILL DR
6TH
5TH
N
SCALE IN FEET
0 200 400 600
LEGEND
Proposed Arteriol Street
Proposed Street Widenings
Proposed Street Extensions
Proposed One Way Street
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED IMPROVEMENTS
GRANDVIEW BOULEVARD AREA
DE LEUW, CATHER & COMPANY CONSULTING ENGINEERS CHICAGO


BILLINGS HEIGHTS
FAIR GROUNDS
LOCKWOOD
STATE HIGHWAY ROUTE 3
ZIMMERMAN TR.
RIMROCK RD.
POLY DR.
COLTON BLVD.
PARKHILL DR.
REHBERG LN.
GRAND AVE
LEWIS AVE
BROADWATER AVE
CENTRAL AVE.
MONAD RD.
KING AVE.
CANAL ST.
24TH ST. W
38TH ST. W
40 TH ST. W
32 ND ST. W
13TH ST. W
19TH ST.
16TH ST.
15TH ST.
12TH ST.
8TH ST.
6TH ST.
5TH ST.
REGAL ST.
DANIEL ST.
MOORE LN.
BILLINGS BLVD.
CALHOUN LN.
ORCHARD LN.
HALLOWELL LN.
JACKSON ST.
WASHINGTON ST.
RIVERSIDE RD.
SUGAR AVE.
GARDEN AVE
VAUGHN AVE.
KRATZ LN.
DIVISION ST.
MONTANA AVE
MINNESOTA AVE
STATE AVE
1ST AVE
4TH AVE
6TH AVE
8TH AVE
9TH AVE
11TH AVE
3RD AVE N
N. 13TH ST
N. 15TH ST
N. 18TH ST
N. 24TH ST
1ST AVE S
4TH AVE S
6TH AVE S
8TH AVE S
YELLOWSTONE RIVER
YELLOWSTONE CREEK
CANAL
NOTE:
Screened Area Represents Recommendations Being Made by Montana Department of Highways
LEGEND
NEW PAVEMENT REQUIRED
Far Street Extensions
Far Street Widenings
Far Channelization
Expressway
Primary Street
Secondary Street
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY
RECOMMENDED STREET EXTENSIONS AND WIDENINGS
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


STATE HIGHWAY ROUTE 3
RIMROCK RD.
POLY DR.
COLTON BLVD.
PARKHILL DR.
GRAND AVE.
LEWIS AVE.
BROADWATER AVE.
CENTRAL AVE.
MONAD RD.
KING AVE.
STATE AVE.
VAUGHN LN.
KRATZ LN.
ZIMMERMAN TR.
REHBERG LN.
38TH ST. W.
40TH ST. W.
37TH ST. W.
32ND ST. W.
CANAL ST.
24TH ST.
19TH ST.
16TH ST.
15TH ST.
13TH ST.
12TH ST.
8TH ST.
6TH ST.
5TH ST.
REGAL ST.
DANIEL ST.
MOORE LN.
BILLINGS BLVD.
CALHOUN LN.
ORCHARD LN.
HALLOWELL LN.
JACKSON ST.
WASHINGTON ST.
RIVERSIDE RD.
SUGAR AVE.
GARDEN AVE.
DIVISION ST.
MONTANA AVE.
MINNESOTA AVE.
32ND ST. N.
30TH ST. N.
27TH ST. N.
18TH ST. N.
15TH ST. N.
13TH ST. N.
9TH ST. N.
6TH ST. N.
4TH ST. N.
1ST AVE. N.
1ST AVE. S.
4TH AVE. S.
6TH AVE. S.
9TH AVE. S.
13TH AVE. S.
15TH ST. S.
18TH ST. S.
27TH ST. S.
BILLINGS HEIGHTS
FAIR GROUNDS
LOCKWOOD
YELLOWSTONE RIVER
NORTHERN PACIFIC RAILWAY
NOTE:
Screened Area Represents Recommendations Being Made by Montana Department of Highways
LEGEND
ADDITIONAL RIGHT OF WAY
For Street Extensions
For Street Widenings
For Channelization
Expressway
Primary Street
Secondary Street
SCALE IN FEET
0 2,000 4,000 6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
NEW RIGHTS OF WAY REQUIRED FOR
RECOMMENDED STREET IMPROVEMENTS
DE LEUW CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

N
MILES
AVE.
WEST
WEST
WEST
WEST
ST.
ST.
ST.
ST.
7TH
6TH
5TH
8TH
ST. JOHNS
AVE.
CENTRAL
AVE.
SCALE IN FEET
0
200
400
600
LEGEND
Proposed Arterial Street
Proposed Street Widenings
Proposed One Way Street
BY OTHERS
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED IMPROVEMENTS
OVERPASS-CENTRAL AREA
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

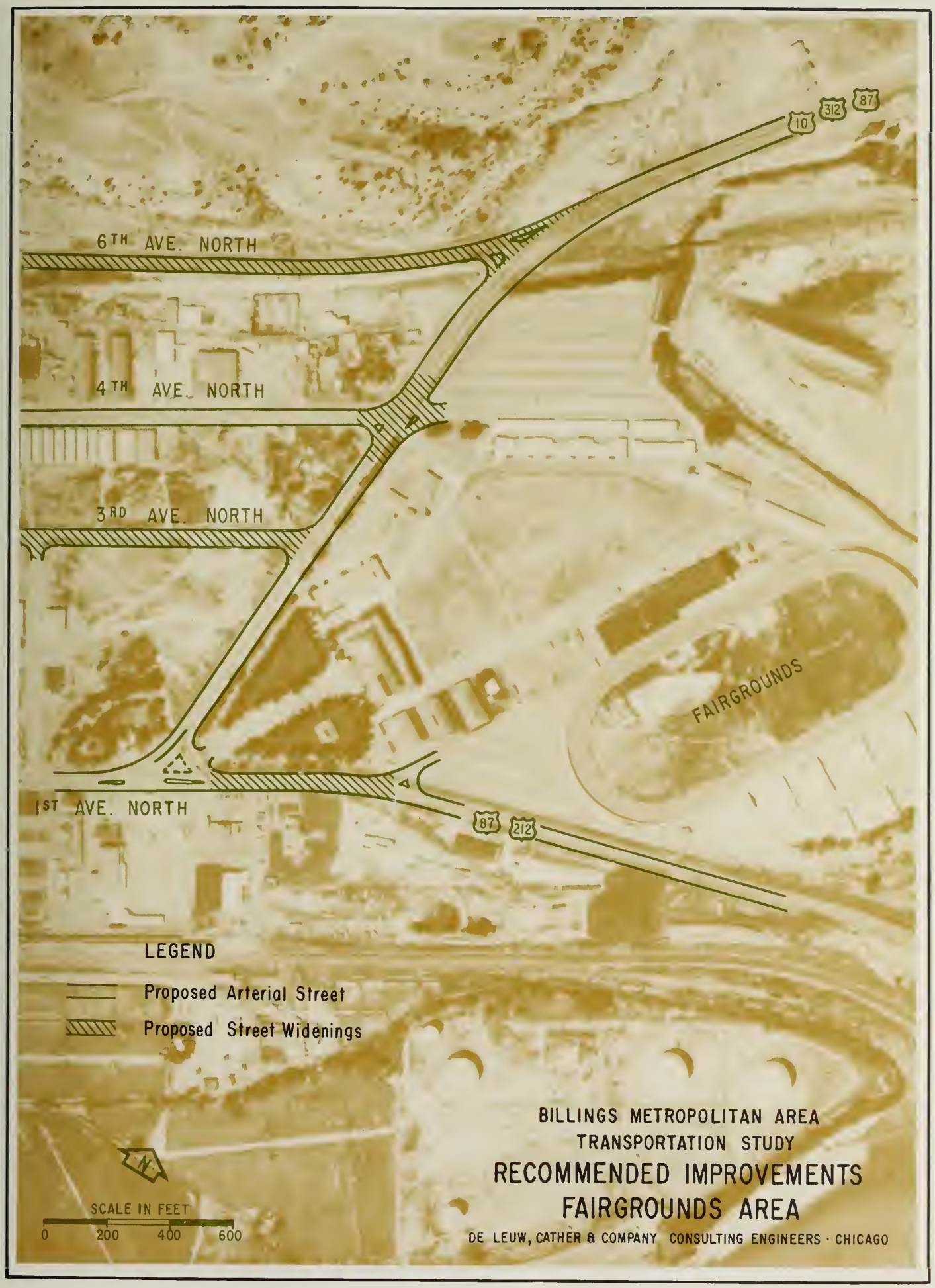
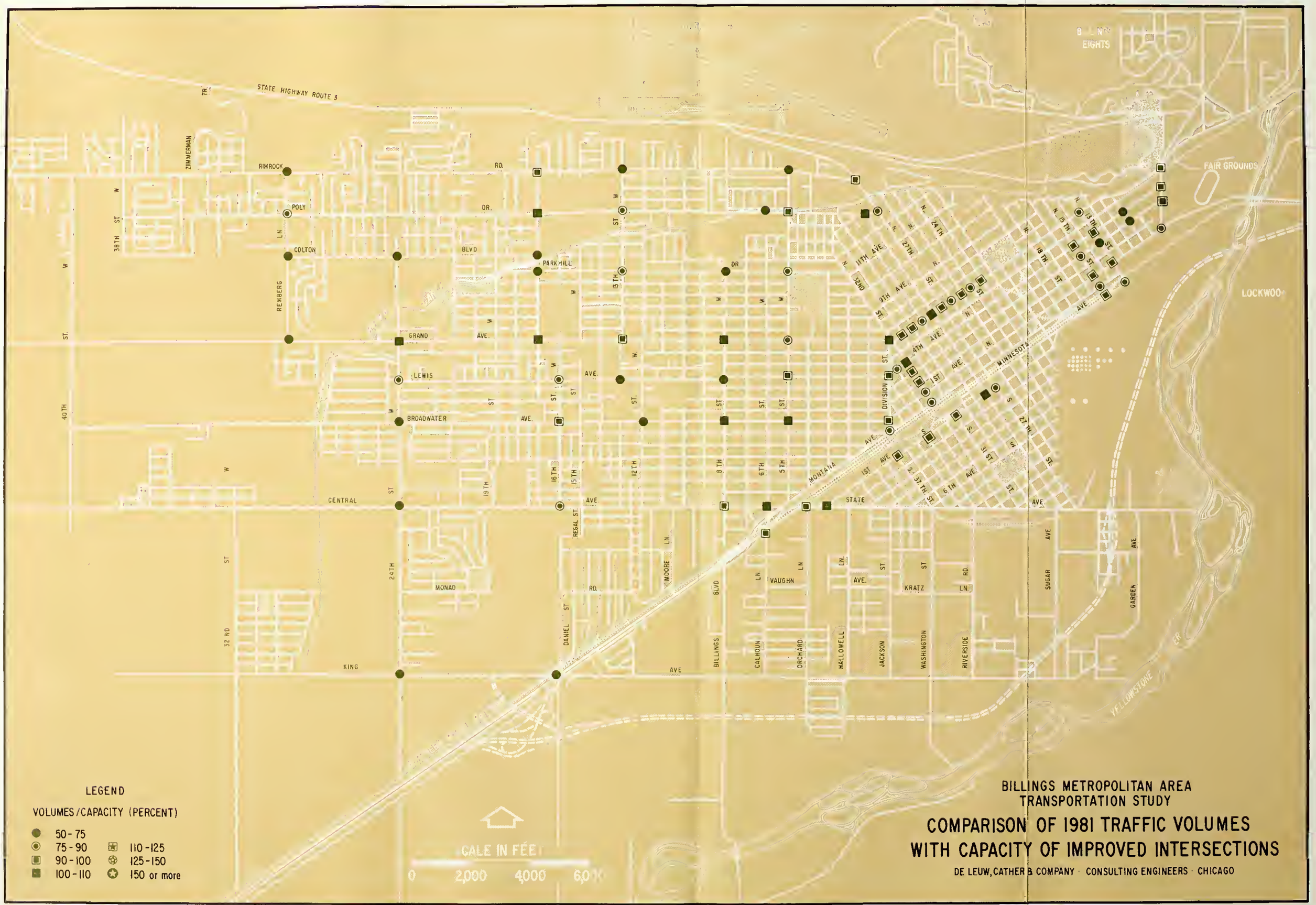

6TH AVE. NORTH
4TH AVE. NORTH
3RD AVE. NORTH
1ST AVE. NORTH
10
312
87
87
212
FAIRGROUNDS
LEGEND
Proposed Arterial Street
Proposed Street Widenings
N
SCALE IN FEET
0
200
400
600
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED IMPROVEMENTS
FAIRGROUNDS AREA
DE LEUW, CATHER & COMPANY CONSULTING ENGINEERS · CHICAGO

EXHIBIT 30

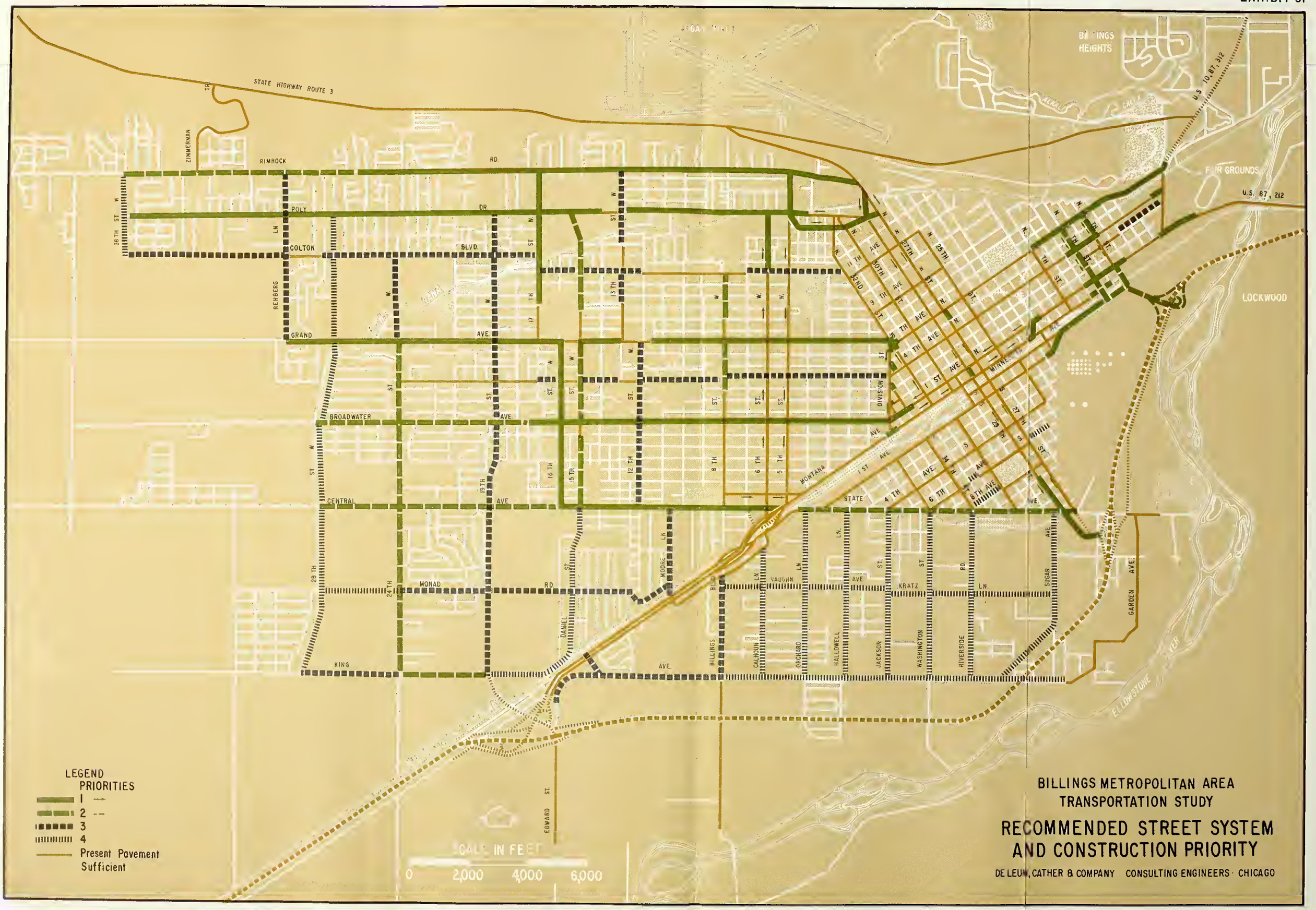


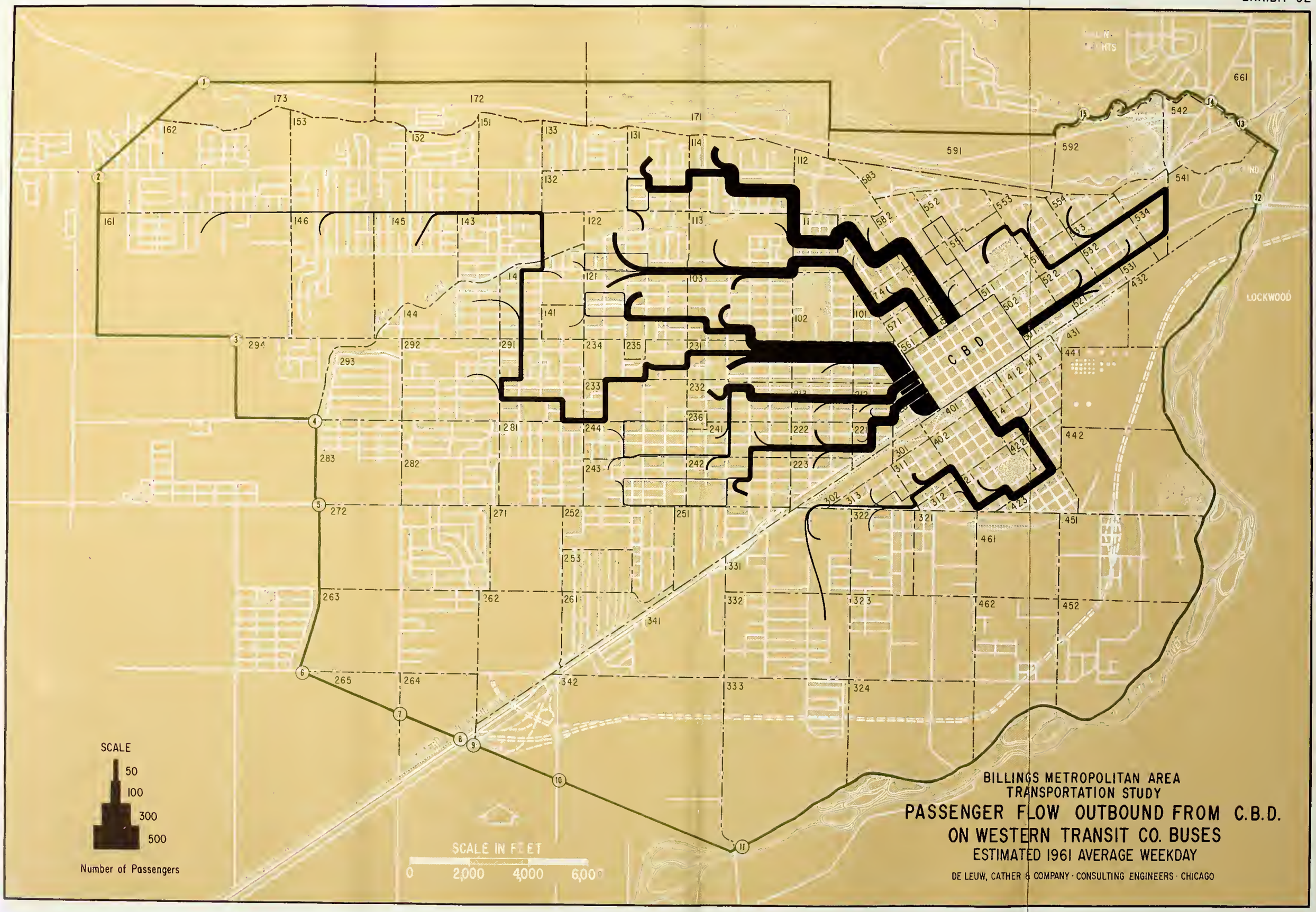
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

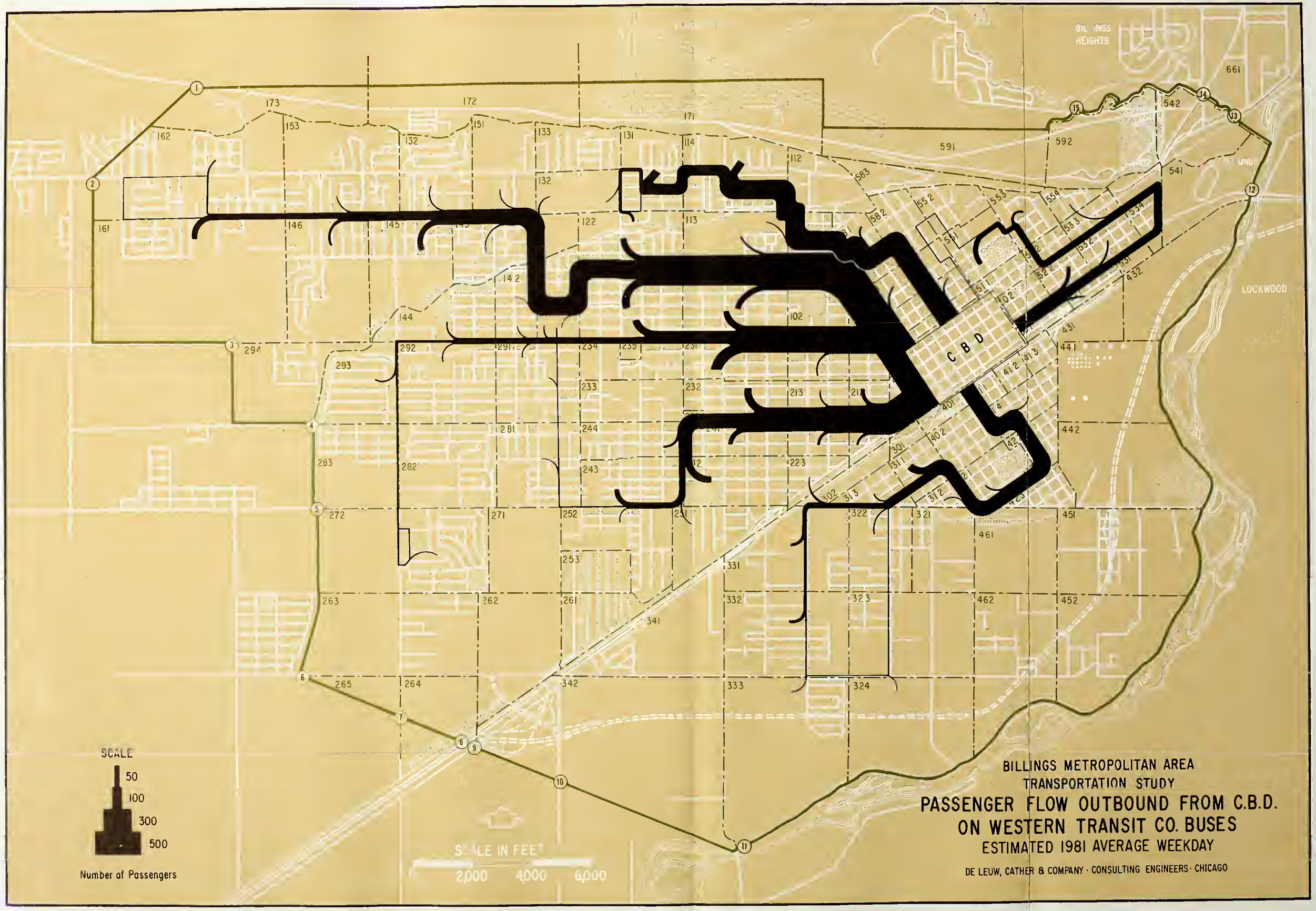
COMPARISON OF 1981 TRAFFIC VOLUMES
WITH CAPACITY OF IMPROVED INTERSECTIONS

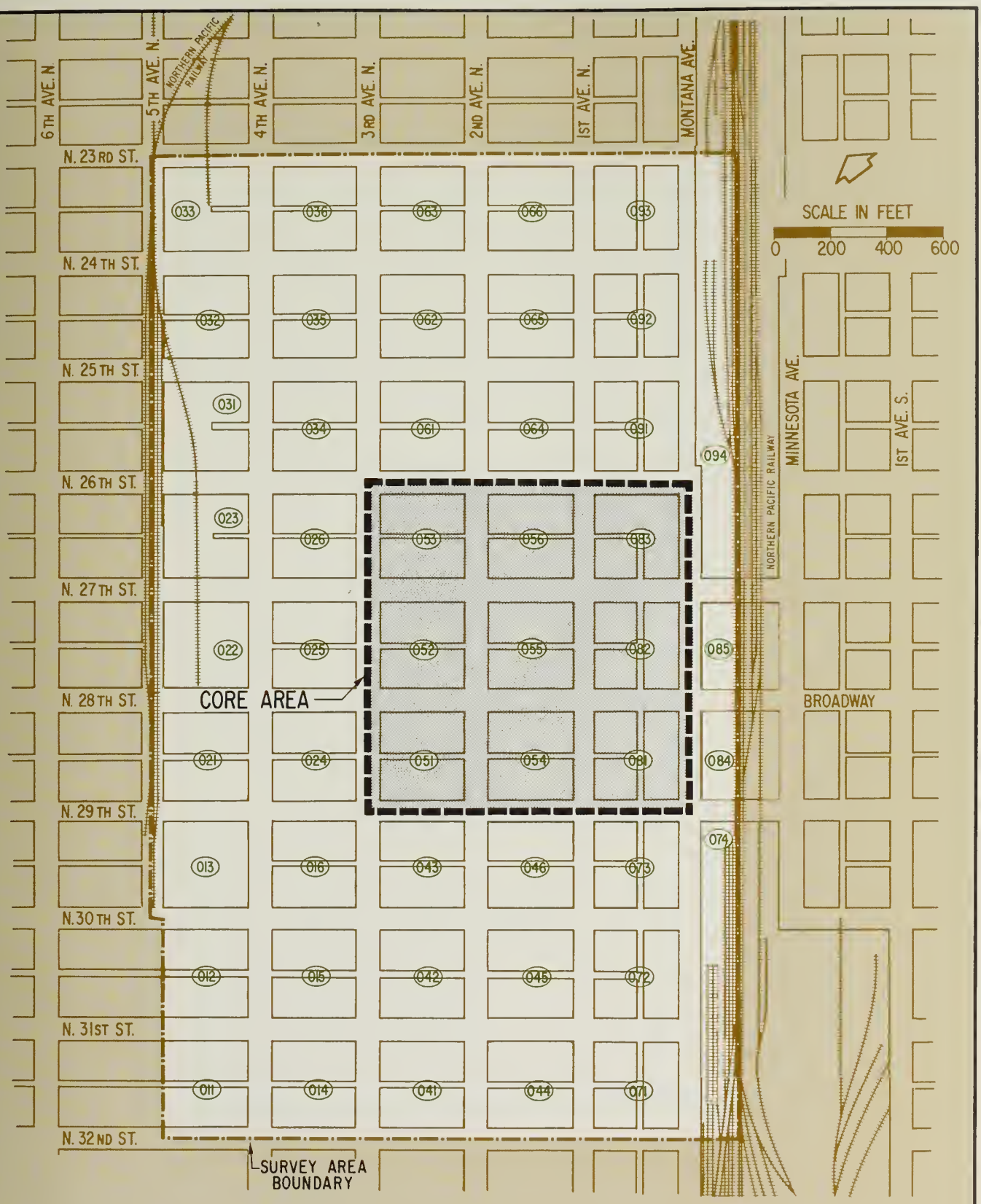
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

EXHIBIT 31


STATE HIGHWAY ROUTE 3
ZIMMERMAN TR.
RIMROCK RD.
POLY DR.
COLTON BLVD.
GRAND AVE.
BROADWATER AVE.
CENTRAL AVE.
MONAD RD.
KING AVE.
38TH ST W
REHBERG LN
29TH ST W
24TH ST W
17TH ST W
19TH ST W
16TH ST W
15TH ST W
13TH ST W
12TH ST W
8TH ST W
6TH ST W
5TH ST W
DANIEL ST
MOORE LN
BILLINGS BLVD
CALHOUN LN
VAUGHN LN
ORCHARD LN
HALLOWELL LN
JACKSON ST
KRATZ ST
WASHINGTON ST
RIVERSIDE RD
SUGAR LN
GARDEN AVE
EDWARD ST
DIVISION ST
MONTANA AVE
STATE AVE
1ST AVE N
4TH AVE N
6TH AVE N
8TH AVE N
27TH ST N
25TH ST N
29TH ST N
32ND ST N
30TH AVE N
27TH ST S
29TH ST S
BILLINGS HEIGHTS
U.S. 10, 87, 312
FAIR GROUNDS
U.S. 87, 212
LOCKWOOD
YELLOWSTONE RIVER
LEGEND
PRIORITIES
1
2
3
4
Present Pavement Sufficient
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED STREET SYSTEM
AND CONSTRUCTION PRIORITY
DE LEUW, CATHER & COMPANY CONSULTING ENGINEERS · CHICAGO


C B D
LOCKWOOD
SCALE
50
100
300
500
Number of Passengers
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
PASSENGER FLOW OUTBOUND FROM C.B.D.
ON WESTERN TRANSIT CO. BUSES
ESTIMATED 1961 AVERAGE WEEKDAY
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


BILLINGS HEIGHTS
LOCKWOOD
C B D
SCALE
50
100
300
500
Number of Passengers
SCALE IN FEET
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
PASSENGER FLOW OUTBOUND FROM C.B.D.
ON WESTERN TRANSIT CO. BUSES
ESTIMATED 1981 AVERAGE WEEKDAY
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO



BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

PARKING SURVEY AND CORE AREAS

DE LEUW, CATHER & COMPANY CONSULTING ENGINEERS CHICAGO

LEGEND

- One-Hour Meter
- Two-Hour Meter
- 12-Minute Meter
- No Restriction
- Two-Hour Time Limit
- 30-Minute Time Limit
- 10-Minute Time Limit
- Miscellaneous or Special Permit
- Loading Zone
- (000) Zone Number
- 00 Number of Spaces

NOTE

Number of Metered Spaces Corresponds to Number of Symbols shown.

Conditions Existing in August, 1961.

BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY

EXISTING CURB PARKING FACILITIES

DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

6TH AVE. N.
5TH AVE. N.
NORTHERN PACIFIC RAILWAY
4TH AVE. N.
3RD AVE. N.
2ND AVE. N.
1ST AVE. N.
MONTANA AVE.
N. 23RD ST.
N. 24TH ST.
N. 25TH ST.
N. 26TH ST.
N. 27TH ST.
N. 28TH ST.
N. 29TH ST.
N. 30TH ST.
N. 31ST ST.
N. 32ND ST.
SCALE IN FEET
0 200 400 600
MINNESOTA AVE.
1ST AVE. S.
NORTHERN PACIFIC RAILWAY
BROADWAY
LEGEND
SURVEY AREA BOUNDARY
Lots
Commercial
Municipal Metered
Customer
Private Use, Employee and Monthly
Garages
Commercial
Private
(000) Zone Number
00 Capacity (Car Spaces)
Note: Conditions Existing in August, 1961
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
EXISTING OFF-STREET PARKING FACILITIES
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

6TH AVE. N.
5TH AVE. N.
NORTHERN PACIFIC RAILWAY
4TH AVE. N.
3RD AVE. N.
2ND AVE. N.
1ST AVE. N.
MONTANA AVE.
N. 23RD ST.
N. 24TH ST.
N. 25TH ST.
N. 26TH ST.
N. 27TH ST.
N. 28TH ST.
N. 29TH ST.
N. 30TH ST.
SCALE IN FEET
0 200 400 600
MINNESOTA AVE.
1ST AVE. S.
NORTHERN PACIFIC RAILWAY
BROADWAY
SURVEY AREA BOUNDARY
SCALE
TRUCKS
CARS (INCLUDING TAXIS)
4,000
3,000
2,000
1,000
NUMBER OF VEHICLES
BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY
TRAFFIC ENTERING AND LEAVING THE SURVEY AREA
9:00 AM–6:00 P.M.
SEPTEMBER WEEKDAY 1961
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

DESTINATIONS OF MOTORISTS PARKED FOR VARIOUS TRIP PURPOSES

AVERAGE WEEKDAY 1961

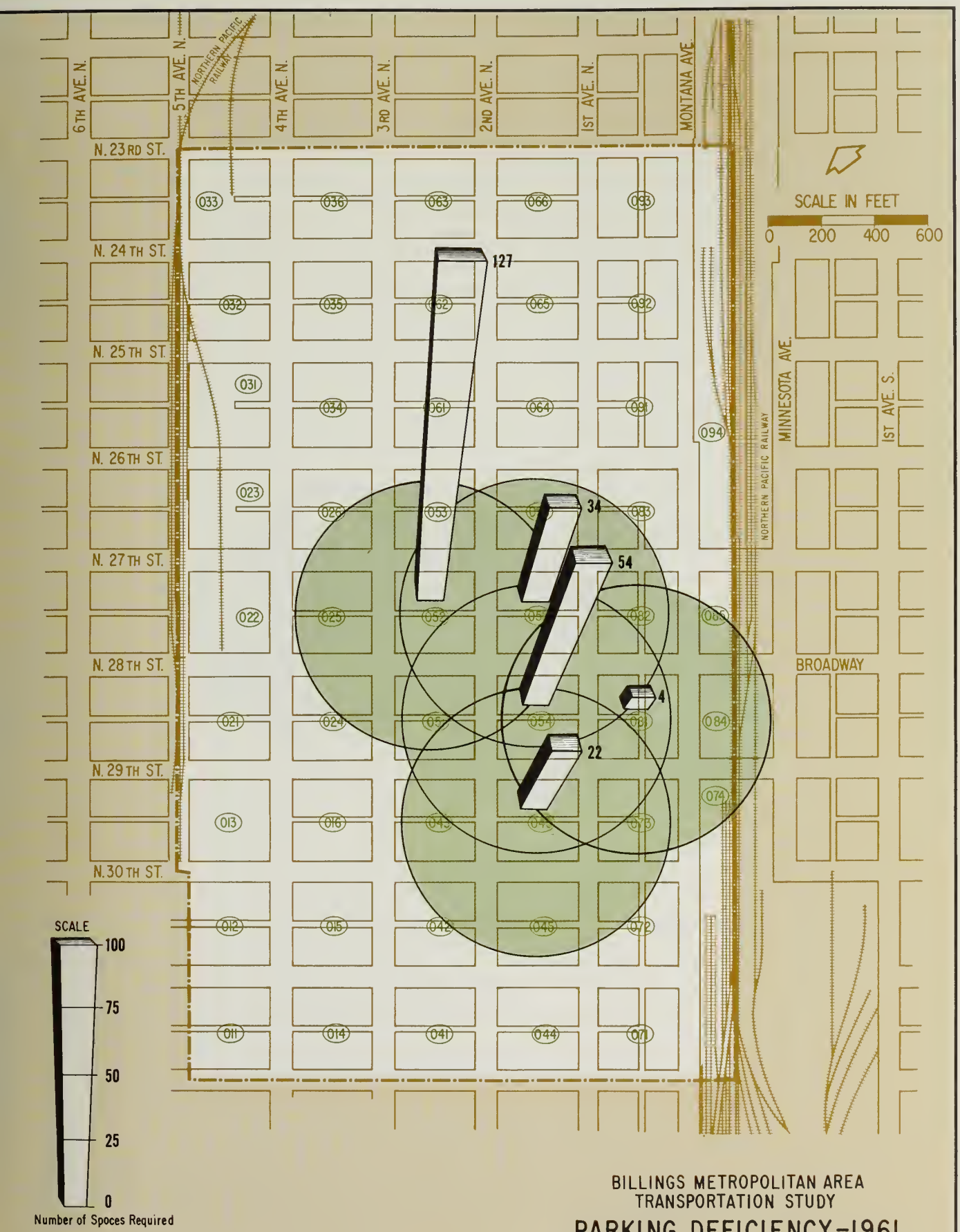
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

SPACE HOUR PARKING SUPPLY, DEMAND AND USAGE

AVERAGE WEEKDAY-1961

DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

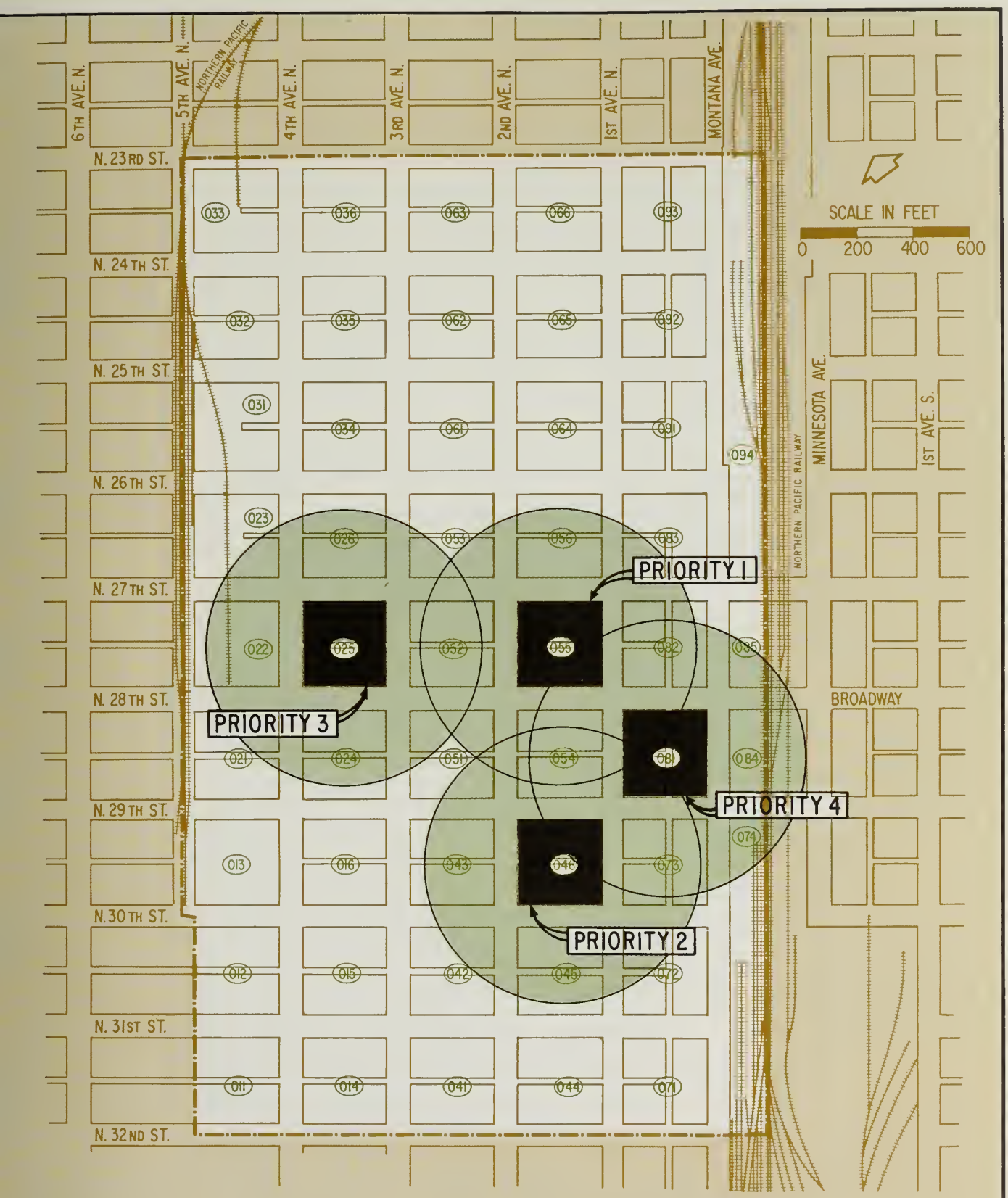


NOTE: Circles Delineate Area Within 350 Feet of Each Block Face in Deficient Blocks.

BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY

PARKING DEFICIENCY-1961 BASED ON PEAK HOUR DEMAND

DE LEUW, CATHER & COMPANY CONSULTING ENGINEERS · CHICAGO



LEGEND

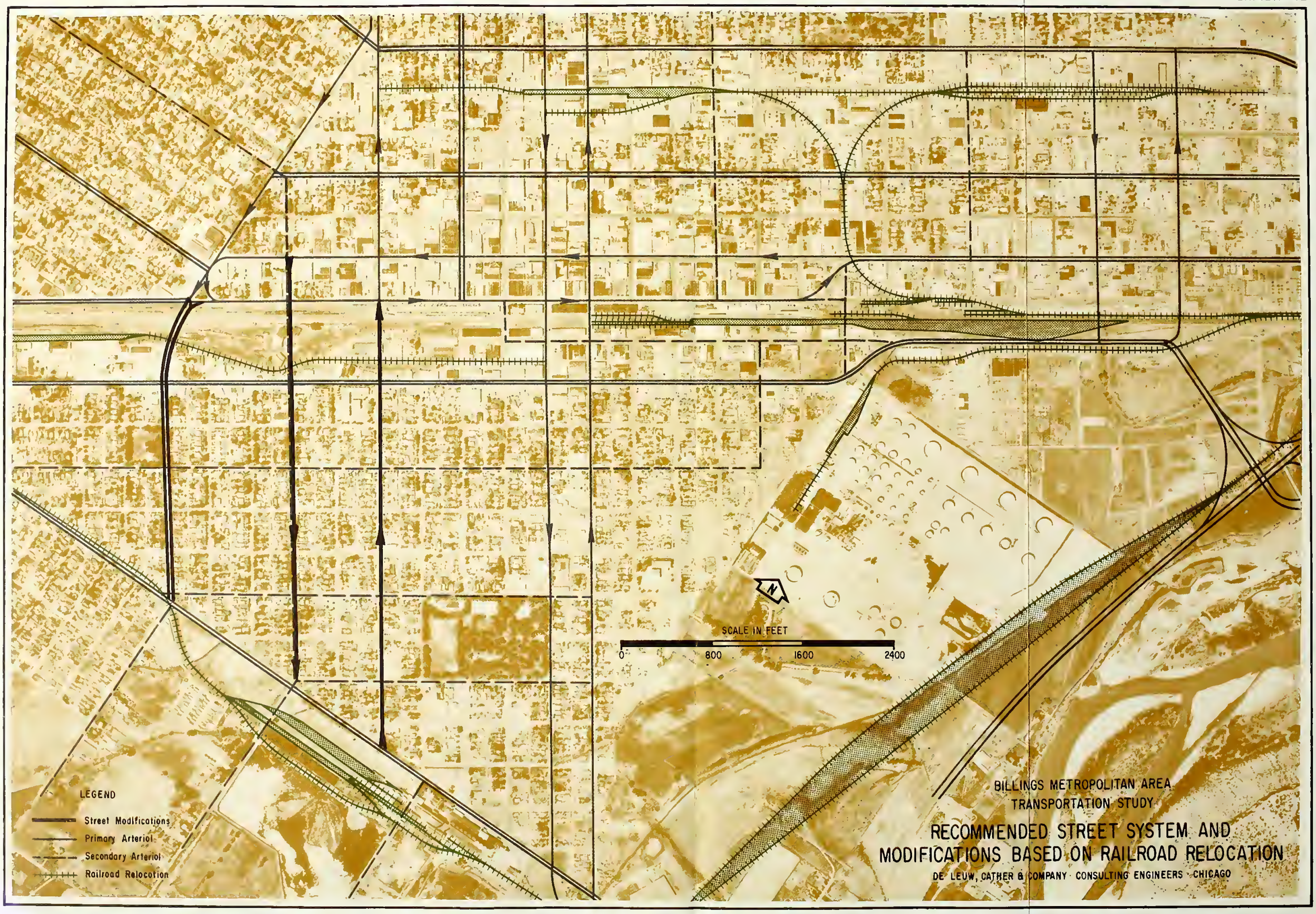
Blocks in Which New Off-Street Parking Facilities Are Recommended.

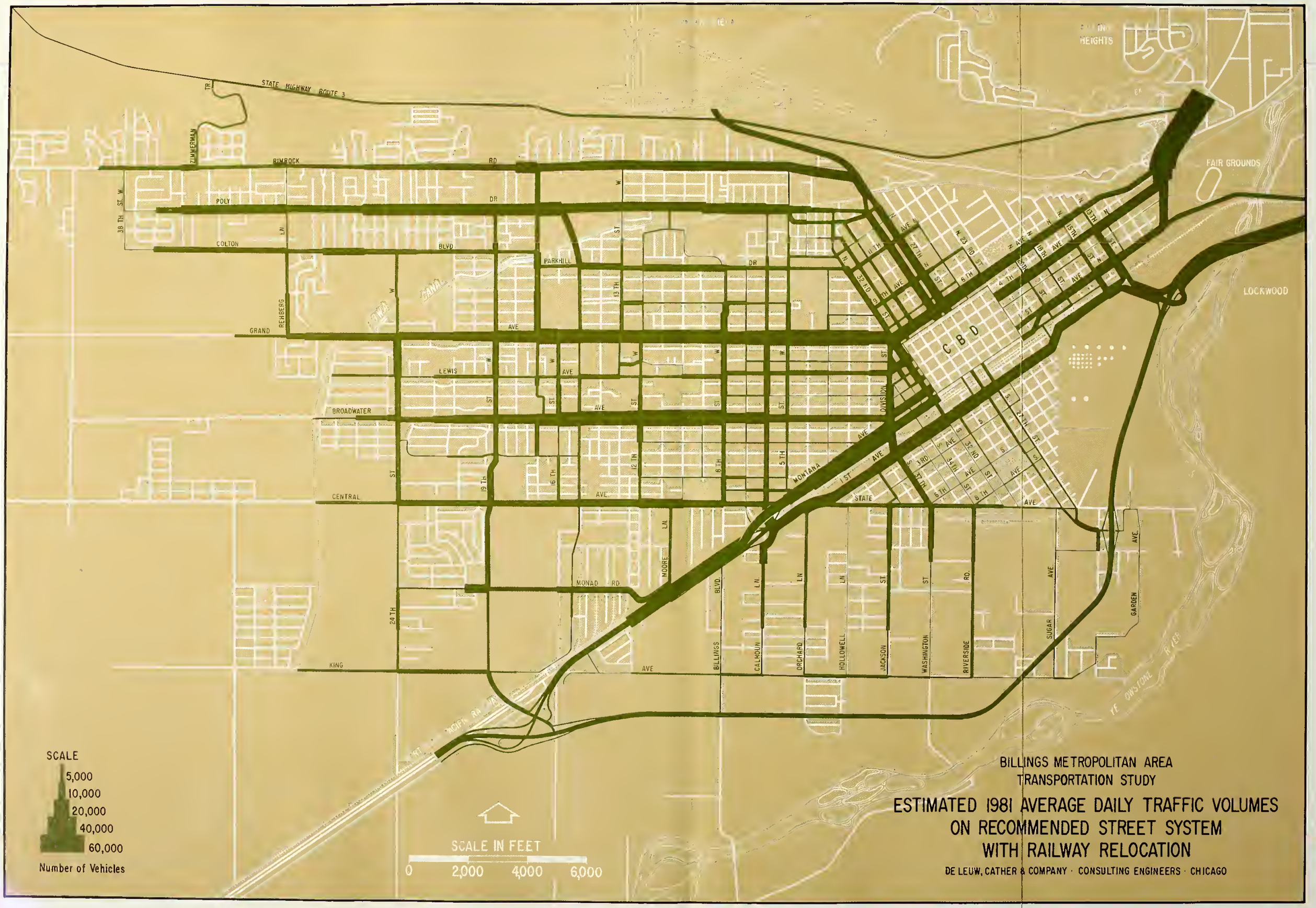
NOTE: Circles Delineate Area Within 350 Feet of Each Block Face in Blocks Selected for New Parking Facilities.

BILLINGS METROPOLITAN AREA TRANSPORTATION STUDY

RECOMMENDED LOCATIONS FOR ADDITIONAL PARKING FACILITIES

DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


N
SCALE IN FEET
0
800
1600
2400
LEGEND
Street Modifications
Primary Arterial
Secondary Arterial
Railroad Relocation
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
RECOMMENDED STREET SYSTEM AND
MODIFICATIONS BASED ON RAILROAD RELOCATION
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO


STATE HIGHWAY ROUTE 3
ZIMMERMAN TR.
RIMROCK RD
POLY DR
38 TH ST. W
COLTON BLVD
PARKHILL DR
REHBERG LN
GRAND AVE
LEWIS AVE
BROADWATER AVE
CENTRAL AVE
MONAD RD
KING AVE
24 TH ST
19 TH ST
16 TH ST
12 TH ST
8 TH ST
5 TH ST
13 TH ST
MOORE LN
BILLINGS BLVD
CALHOUN LN
ORCHARD LN
HOLLOWELL LN
JACKSON ST
WASHINGTON ST
RIVERSIDE RD
SUGAR AVE
GARDEN AVE
MONTANA AVE
1 ST AVE
STATE AVE
DIVISION ST
32 ND ST
27 TH ST
23 RD ST
6 TH AVE
4 TH AVE
16 TH AVE
15 TH ST
21 ST ST
37 TH ST
34 TH AVE
3 RD AVE
17 TH ST
8 TH AVE
CANAL
C B D
FAIR GROUNDS
LOCKWOOD
HEIGHTS
YELLOWSTONE RIVER
SCALE
5,000
10,000
20,000
40,000
60,000
Number of Vehicles
SCALE IN FEET
0
2,000
4,000
6,000
BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY
ESTIMATED 1981 AVERAGE DAILY TRAFFIC VOLUMES
ON RECOMMENDED STREET SYSTEM
WITH RAILWAY RELOCATION
DE LEUW, CATHER & COMPANY · CONSULTING ENGINEERS · CHICAGO

APPENDIX

APPENDIX

DEFINITIONS OF TECHNICAL TERMS

Arterial Highway - A general term denoting a highway primarily for through traffic, usually on a continuous route.[1]

Average Daily Traffic (ADT) - The average 24-hour volume, being the total volume during a stated period divided by the number of days in that period.[1]

Basic Capacity - The maximum number of passenger cars that can pass a given point on a lane or roadway during one hour under the most nearly ideal roadway and traffic conditions which can possibly be obtained.[3]

Billings Urban Area - Comprised of 1960 census enumeration districts 1 through 54 in Yellowstone County, with the exception of district 49-S, and a small portion of the "Billings West" district.

Capacity - The term, without modification, is simply a generic expression pertaining to the ability of a roadway to accommodate traffic.[3]

Census Enumeration District - Areas into which certain cities have been subdivided by the Bureau of Census for developing population and other statistics.

Central Business District - The 49 blocks that comprise the center of shopping and business activity in Billings, bounded by the railroad tracks on the north and south, North 23rd Street on the east, and North 32nd Street on the west.

Classification Count - Manual count of vehicles passing a specified point classified as to type, i.e. in-state or out-of-state, passenger car, bus, taxi, or various types of trucks.

Collector Street - Roadways which gather traffic from residential areas and feed into primary or secondary arterials.

Commercial Vehicles - Trucks and Buses.

Committed Arterial Street System - The present arterial street program which is in the process of development.

Cordon Line - The boundary of the area being studied.[5]

Cordon Station - Locations on each street crossing the cordon where all vehicles are counted and classified.[5]

Core Area - Nine blocks in the central business district having the greatest demand for parking space, bounded by Montana Avenue on the south, North 29th Street on the west, Third Avenue North on the north, and North 26th Street on the east.

Desire Line - A straight line between the points of origin and points of destination of a trip without regard to routes of travel--used in connection with origin and destination study.[4]

Destination - The location of the objective of the trip.[5]

District - A major subdivision of the area used in analysis of origin-destination data and route assignment. Larger than a zone but smaller than a sector.

Dwelling Unit - In general, a dwelling unit is a group of rooms or a single room, occupied or intended for occupancy as separate living quarters, by a family or other group of persons living together or by a person living alone.[7]

Efficiency Factor - A factor used to convert "theoretical" available parking space hours into "practical" space hours. This procedure is necessary to compensate for time lost in entering and leaving parking spaces, as well as normal fluctuations in demand day to day or hour to hour. In this study, the efficiency factor used was 0.90 percent for curb parking space hours and 0.85 for off-street parking space hours.

Expressway - A divided arterial highway for through traffic with full or partial control of access and generally with grade separation at intersections.[3]

External Area - The area outside of the external cordon line.

External Cordon Line - The boundary of the survey area.

External Station - The intersection of each street or highway with the external cordon line.

External Survey - That phase of a survey involving the interviewing of drivers at selected highway stations.[6]

Generalized Land Use - The predominant utilization of land in each block or other sub-area of the total internal survey area.

Gross Residential Area - All land area which is presently or potentially residential including area devoted to streets and alleys.

Ground Count - Actual count of all types of motor vehicles made at control points, roadside interview stations and screen line stations in an origin and destination study.[4]

Illegal Parking - Parking in any place contrary to ordinance or police regulations. The term does not include overtime parking.[5]

Internal Survey - A phase of the study in which trip data were obtained by interviewing the residents of a pre-selected dwelling unit sample and the operators of a representative portion of taxicabs and trucks registered inside the cordon line.

Internal Survey Area - The area encompassed by the external cordon line.

Internal Trip - Travel from one point to another wholly within the internal survey area.

Legal Parking - Parking at curbs or in lots and garages intended and designated for that purpose and where permitted by ordinance.[5]

Link - Sections between intersections to which time and distance values were given for the purpose of traffic assignments.

Mode of Travel - The type of transportation selected to move from one place to another, i.e. auto, bus, taxi, walk, etc.

Net Residential Area - All land area upon which dwelling units are constructed including area devoted to streets and alleys.

Off-Street Parking Facilities - Lots and garages intended for parking and entirely off public streets and alleys.[5]

One-Way Pair (Couplet) - Two companion streets on which the movement of traffic is confined to one direction on each street and on which the flow of vehicles on one street is opposite to that on the other.

Origin - The stated beginning point of a single trip.

Origin-Destination Study (O-D Study) - A study of the origins and destinations of trips of vehicles and passengers. Usually included in the study are all trips within or passing through, into, or out of a selected area.[4]

Overtime Parking - Parking for longer than permitted by ordinance.[5]

Parking Data Book - "Basic Data on Parking -- Billings Metropolitan Area Transportation Study", De Leuw, Cather & Company, Consulting Engineers, Chicago, March 1962.

Parking Demand - The need for parking space as indicated by the actual destinations of the drivers now parking in the central business district. It may be expressed in parking spaces or space hours.[5]

Parking Destination - The first location to which the driver goes after parking--not where a driver parks.

Parking Facility - A curb, lot, or garage intended for the parking of vehicles.[5]

Parking Space - An area intended for occupancy by a parked vehicle.[4]

Parking Turnover - The rate of usage of a parking facility or the number of times that a parking space is used in a stated time. For a facility, a type of facility, or an area, the rate equals the number of vehicles parking divided by the number of parking spaces.[5]

Parking Usage - The number of vehicles parked or the number of space-hours used by vehicles that parked.[5]

Passenger Car - A motor vehicle designed for the transportation of not more than eight persons. The term includes taxicabs, limousines, and station wagons.[1]

Peak Hour of Parking - The hour in which there was the grestest accumulation of parked vehicles in the survey or core area.

Person Trip - Travel from one point to another by an individual in the survey area.

Possible Capacity - The maximum number of vehicles that can pass a given point on a lane or roadway during one hour, under the prevailing roadway and traffic conditions.[3]

Practical Capacity - The maximum number of vehicles that can pass a given point on a roadway or in a designated lane during one hour without the traffic density being so great as to cause unreasonable delay, hazard, or restriction to the drivers' freedom to maneuver under the prevailing roadway and traffic conditions.[3]

Primary Arterial - Provides reasonably continuous route through the whole or a portion of a city and generally connects with the principal highways radiating from the urban area.[2]

Private Lot or Garage - A lot or garage intended for use by certain groups or individuals and not for general public use.

Prohibited Curb - Curb spaces where parking is prohibited during posted hours.[5]

Public Lot or Garage - Those lots or garages open to the general public for parking regardless of trip purpose or destination.

Purpose of Trip (Trip Purpose) - The primary reason for travel, i.e. work, social, medical, business, shopping, etc.

Rectangular Table - A tabulation on which all trips are shown "from" one zone or station "to" another and represent one way travel. To determine total trips between any two zones, the trips for each direction of travel must be added together.

Sample Tree - The aggregate of all routings from one zone centroid to all other zone centroids. Used in traffic assignments.

Screen Line - An imaginary line dividing the internal survey area into two parts. Used in evaluation of survey accuracy.

Secondary Arterial - The main feeder and connecting street between the primary arterials.[2]

Sector - The largest division of the study area used in analysis of origin-destination data and route assignment.

Space-Hour (Practical) - Applied only to space-hours of parking supply. It is the product of the theoretical space-hours multiplied by the efficiency factor.

Space-Hour (Theoretical) - One parking space for one hour. Used to measure supply, usage and demand on a comparable basis. It is reduced through loss of time in each turnover of space and through the fact that supply and demand are not parallel throughout the day.

Special Permit Parking Space - Curb parking space officially reserved for use by a designated person or group.[5]

Sufficiency Rating - Traffic Volume divided by capacity.

Survey Area - Bounded on the north by a line paralleling the rimrocks and including the airport; on the east and south by the Yellowstone River; and on the west by the Billings Bench Water Association Canal and a line east of 40th Street West.

Through Trip - That part of the traffic circulating within a given area, or at a given point in that area, having neither origin nor destination within the area.[6]

Traffic Assignment - The distribution of traffic to the various segments of a proposed system.

Traffic Data Book - "Basic Data on Traffic - 1961 -- Billings Metropolitan Area Transportation Study", February 1963, De Leuw, Cather & Company, Consulting Engineers, Chicago.

Trip - The one-way travel between origin and destination.[4]

Trip End - The place of destination.

Truck Loading Dock - Off-Street space reserved for use in loading or unloading of trucks.[5]

Truck Loading Zone - Curb space reserved by ordinance for use in loading or unloading trucks.[5]

Vehicle Occupancy - All persons in the vehicle including the driver and passengers regardless of age.

Vehicle Trip - Travel from one point to another by a vehicle.

Zone - The smallest subdivision of the area used in analysis of origin-destination data and route assignment.

[1]"A Policy on Geometric Design of Rural Highways", American Association of State Highway Officials.

[2]"A Policy on Arterial Highways in Urban Areas", American Association of State Highway Officials.

[3]"Highway Capacity Manual", Bureau of Public Roads, U.S. Department of Commerce.

[4]"Traffic Engineering Handbook", Institute of Traffic Enginers.

[5]"Parking", Eno Foundation.

[6]International Traffic Engineering Vocabulary.

[7]"1960 Characteristics of Housing", Bureau of Census, U.S. Department of Commerce.

BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

TOTAL PERSON TRIPS - AVERAGE DAY 1981 - INTERNAL

TABLE C-1(1981)

To Zone	001 002 003 004 005	006 007 008 009 101	102 103 111 112 113	114 121 122 131 132	133 141 142 143 144	145 146 171 172 173	161 162 171 172 173	201 202 211 212 213	214 221 222 223 231	232 233 234 235 236	241 242 243 244 251	252 253 261 262 263	264 265 271 272 281	282 283 291 292 293	294 301 302 311 312	313 321 322 323 324	331 332 333 341 342	401 402 411 412 413	414 421 422 423 431	432 441 442 451 452	461 462 501 502 511	512 521 522 531 532	533 534 541 542 551	552 553 554 561 562	571 572 573 574 581	582 583 591 592	DIRECT TOTAL	To Zone
From 001	57 18 21 16	14 29 51 36 42	49 173 97 15 24	54 108 39 17	132 24 37 28	12 3	12 3	55 101 73 41 47	52 25 100 30 70	10 26 51	17 164 21 31	42 9	24 92	42 32	20 9 10 11 15	26	46 28 14	30 9 0	0	22	8 16 70 11 72	0 25	13 15	0	93 8 95 23 151	69 51	3945	from Zone
Zone 002	173 80 0 198 280	51 77 200 44 16	58 103 144 137 120	39 267 105 97	35	35 157 100	12	26	13 0	35 9 17 50	101 92 10 74 32	40	10	10	50 97 108 137	5 60 49	22	22 13 13	11	13 51	14 30	128	34 52	10 14 0 37 55	52 3 123 118 846	0 3	7772	002
003	80 80 14 863 87	8 17 31 7	149 28 42 74	94 135 35 30	10 198 35 35	95 135 49 16	17 247 247 237 157	10	29	9	13	17 137 55 54	59	2 6 2	7	4	7	7	4	51	41	128	34 52	17	12	12	700	003
004	191 294 13 259 448	150 38 301 84 115	99 939 40 80 179	194 378 241 170 6	56 471 61 111 75	275 160 101	275 160 101	59 158 45 139 150	199 122 59 101 251	300 80 194 154	99 176 166 46 191	80 11 29 11	12 124	204 167	154 104 152 124 215	44 21 197 38	80 11 29 11	14	3 20 17	83 66 186 153 200	277 17	35 16 23 1 38	83 66 186 153 200	277 17	13910	004
006	25 143 2 50 76	41 31 66 31 3	21 58 23	3 27 10	14 68 25	10	35	73 20 37 8	8 11 7 37 32	8 30 9	25 24 17 9	0 80 0 19	26 3 5 3	12 12	20	9 10 8	0 7 7	12 5 9	11	21	33 32 7 44 10	7 6 1	9	10 40 7 29 30	9	1980	006
008	40 40 102 52	22 45 74 29	25 49 28 32	10 101 133 212 73	25 51 61 94 24	101	182 421 2	91 199 98 30 52	94 71 50 87 70	101 55 92 107 74	142 97 70 32 159	120 13 15 13 3	12	0 59 11	7 40	10 29 22 25 16	8	11 80 51 34	19	7	13 16	8	7 8 22 14	7 8 22 14	49	2873	008
009	59 23 5 22 75	75 42 115 92	41 63 43 19	1 24	22 13 13 13	25 135	25 135	58 96 8	22 9 23 19	42 9 23 19	4 26	12 2 5 2	6	7 7 7	4	49 82 34	18 28 56	39 62 34 28	15	3	7	7	7	7	7	1033	009
101	22 51 11 18 105	17 9 7	47 10 16	44 2 3 13	55 25 15 55	26	11	91	8	8 30	7	0	10 29 22 25 16	8	0	10	19	11	7	7	7	7	7	7	7	2617	101
102	79 121 24 22 42	7 114 3	9 129 53 88 94	81 84 201 76 8	43 171 19 13	131 35 230 46 34	25 67	42 104 7 29 15	8 62 99	25 112 64 85 12	11 80 51 34	39	33 12 17 78 116	120 38 39 4	55 11	72 18 10	79 55 11 111	10 20	7	30 13 57 26	13	32 30 57 1 250	55 11	17 46 5	32 30 57 1 250	55 11	7521	102
103	145 254 29 108 483	45 14 42 22	7 9 7 3	40 26 76	26 33 61 10 7	35	22 124	10	44 2 2 33	16 26 42 128 19	38 40	15	10 22	169 18 100 40 45	79 50 11 171	19	11	7	7	7	7	7	7	7	7	2423	103
112	75 19 7 8 21	17 9 7	7	70	33 7	37 10	22 83 48	26	22	33	15	7 7 7	7	7	7	7	7	7	7	7	7	7	7	7	7	1121	112
113	36 122 8 95 100	53	115 137 42 1 46	49 59 99 48 13	14 71 42 20 37	39	24 64	24	40 8 10	40 8 10	64	24	7 11	11	1 5 1	7	7	7	7	7	7	7	7	7	7	1113	113
114	48 73 30 103 326	5 19 74 27 95	131 25 30 49 54	114 51 71 43 26	14 178 18 15 6	3 21 57 14	50 179	19 56	18 40	15 170	5 19 16 95	5	9 3 7 3 29	45 14 10	99 19 7 3 29	17	31 9 72 9 10	1 34	5 0	0 0 45	11	29 30	13 12 10 1 21	6	35 8 36 29 102	74 18	3036	114
121	22 13 2 50 76	16	22	10 146 296 74 21	93 245 35 21 49	32 75 141 18	78 135	51	10 23 204	22 25 156 334 205	20 128	12	10 28 10	34	34	44	11 34 13 72 32	12 24	8	9	113	15	15 36 24 14 23	23	81 10 74 140 103	42 20	2815	121
122	91 97 191 210	53 37	12	29 157 41 36 29	10 145 125 24 39	30 75 141 18	78 135	24 78	10	24 78	25	8	1 13 1 78	10	8	8	8 66 11 22	7	7	7	7	7	7	7	7	2542	122
131	6 65 59 141	6	12	21 76 29	7 11 14	136 12 51	92	6 19	8	24	6 19 18	10	8	32 12	7	7	32 12	7	7	7	7	7	7	7	7	1192	131
132	29 49 90	0 30 11	9 74 30 6	45 133	37 5 50 108 15	37	45	20	47 12	20	166 075 330 95 126	127 0 23 5	84	20	42	265 306 735 199 390	96	53 10	92 175 277 110 17	16 45 11 19	10	32	5	7 32	34	1451	132
141	10 56 18 92 118	46 7 64 12	41 515 47 19 37	397 550 121 109	121 27 503 515 377	40 55 101	129 30	61 81 169 70 74	13 9	112	57 320 86	127 0 23 3	3	13	7	13	13	10	30	30	56	5	8 8 82	116	7 27 22	10 22 13	7	12004	141
142	8 117 34 76	8	8	152 36 220	24 655 13 12	12	12	37 11	11	39	16 87	11 3 10 3	3	125 79	37 35	154 39	30 143 50 228 106	78	9	16	8	8	16	8	8	2707	142
143	106 7 6 70	31 20	8	104 90 29	7	7	7	23 60 35 28	10	39	32 78 157 44	8 11 13	3	154 39	30 143 50 228 106	78	9	16	8	8	16	8	8	8	8	3095	143
145	149 12 96 63 62	63 62	14 70 24 16 17	551 26 69 96	230 266 96 70 437	172 230	41	51	174 104	41	43 47 20 17	32	18 20	29	204 77 38 61 48	61	25	76	19 29	15	19	16	13	10	26	24	13 41 64 152 53	37 41	5525	145
151	17 85 197	26 66	7 37 115	122 18 75	247 119 84 140	1100 224 226 343	716 10 107	52 25 66	12	127 76	27 60 31 26	77	32	140	44 113 43	50	22 74	74	15	20	40 20	15	12 10 7	10	42 24 72 52	12 15	6414	151
152	404 37 91 102 419	30 167 29	10	46 64	36 111	603	303 67	41	22	276 123 64	11 91	12	10	64	125 10 158 52	50	20	85	9	9	9	9	9	9	9	4475	152
153	22 44 134 183	35 17 110 76	75 23 48 24	22 167 90 29 51	14 831 65 211 67	291 103 120 133	351 769 136	10	30	75 106 25	11 92 70	30	22	12	10	90 151 24	41	9	14	41	11	12 10 7	10	10	42 24 72 52	12 15	4475	153
161	12 112 95	25 214 22 125 64	58 317 76 76 92	411 607 129 267 271	772 716 58 376 451	31 471 240	37	37 41 61	90 60 90 264 76	24	30 97 32 59 67	72	9	14 64 116	121 34 126 139 109	222 20	144 59 150 80	11 27 42	25	10	30	12 12	14	42	16	26	9 66 12 71 529	12 70	11187	161
162	20 70 17 40 144	35 21 45	129 137 50 15	111 140 55 18	107 70 90 105 32	36 147	216 8	240 95	29	72 70	25 30 24	76	13	26 14	134 143	130 46	17	24	17	12 35 13 18 14	19 19	8	10	9	19	40	203 90	43 204	162
163				10															17 85	7 37	2	8	2	2	8	7	36	15	104	163
201	45 105 50 28 89	40 26 60 47 62	12 51 57	29 52 8	79 29 20 06	46	51 69	46 43 16 1	30 27 35 113	56 10 95 34 15	7 50 12 35 11	6	55	30 57	30 10	51 20	80 26	59	24	17	12 35 13 18 14	19 19	8	10	9	19	10	7	37	201
202	70 54 8 34 211	46 99	9	70 108 10	105	38 50	13 67	70 08 10 29 33	30	28 15 18 10	37 0 8	2 6 2	55	10	19 23	31 6	53 114 83 84	7	7	37	7	37	7	7	7	37	7	7	37	202
203	62 54 46 99	45 92 6	8	33 71 13	7	41	41	29 14 14 11	10	13	12	1 5 1 20	20	10	19 23	31 6	67 16 9 79 20	7	7	7	7	7	7	7	7	7	7	7	203
204	26 75 10 66 120	8	8	76 47	8	8	8	20 3 9 15 5	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	204
211	26 75 10 66 120	8	8	76 47	8	8	8	20 3 9 15 5	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8	211
212	93 19 10 33 144	15 160 21 1	35 11	126	74	2	25 12	12	10 6 0 22	19 102	17 14 20 24	19	6 3 10 2	15 13 26	27 36	15 15 38	14	11 37 32	35	4	4	40	6	6	9	4	6	6	212
221	24 20 4 7 12	8	8	8	5 53 15	10	26	37	20 49 21 60	60	14 43 13 43	17	1 1 1 136	15 13 26	27 36	15	10 13	226 25	6	9	9	9	9	9	9	9	9	9	221
222	97 47 12 18 169	7 21 79 23	7	10	51	10	26	20 50 20 23	7 52 41 49	16 30 21 35 59	14 43 13 43	17	23 3 7 20 7 115	55 28	66 100	24 41 40 45	109 22	11 37 32	35	4	4	40	6	6	9	4	6	6	222
223	85 142 132 275	31 51 98 47	99 65 61 15 43	30 196	24	32 107	47	53 51 276 88 37	13	32	10	61 76 102	13	15	66 100	74 112 12 39	54	23 13	15	16	50	9	58	9	58	23	23	223
232	9 100 30 35 53	35 141 24 8	13 33 38 8	5 62 72	11	51	31	90 84 53	81 20 33 144 80	69 23 11 64	59 11 30 11 29	20 10	28 33	16 47 74 10 19	29	21	45 59 9 34 11	30 24 55 7	1	1	37	140	9	16	12	9	9	16	232
233	10 30 9 94 210	7 8 17 7	35 58 90	17 165	90 74	50	32 64 65	41 105 294 339 66	50	32 64 65	86 22 94 92 12	7	36	30	15 9 220 144	265 14 134 245 249	75	51	15	14	22	26	9	19	15	16	17	233
234	20 30 9 24 84	16	37 107 47 8	251	21	48	31	45 49 332 44 83	45	332 44 83	171 92 310 121 62	145 2 8 2 39	39	37 17	940 166	17 97 92 422 234 269	37 24 9	19	37 24 9	19	22	26	9	19	15	16	17	234
235	20 47 7 9 108	19 8	7	11 42 104 10	10 80	20	23	66 96 106 97 17	66 96 106 97 17	173 114 105 62	24	2	22 59	205 111	42 22 53 30	13	22	22	13	13	13	13	13	13	13	13	13	235
236														205 111														236
241	11 74 1 59 164	9 16 131 22	7 67 15 31 32	27 76	27 32	37 13	30 75	11	75 90 109	106 31 117 42 36	120 178 134 77 34	169 3 16 3 54	20 10 8 51 28	48 24 99 72 12	7	5	35	3	3	13	34	7	5	9	1 41 0	10	9	241
242	131 96 6 80 247	14 17 38 6	103 37 5	39 34 23	13 16 19	75	99	16 16 64 91	16 16 64 91	68 38 118 93	163 135 224 85 9	91 11 7 1 35	22 22	106 110	8	10 26 34	10	9	11	22	8	13	13	13	13	13	13	242
243	13 104 11 43 196	9 22 139 48	9	16 101 26	11	24	13	16 130 61 420 105	16 130 61 420 105	19 420 105	686 6 20 6	5	46 25	205 111	45 91 104 33 51	36	10	9	11	11	11	11	11	11	11	11	11	243
244	12 12 9 42 32	90 17 93 12	7	37 20 13	10	37	13	73 114	73 114	73 114	12	2	46	10 128	21	33	33	20	15	10	21	56	9	16	12	13	10	244
251	12 9 42 32	90 17 93 12	7	37 20 13	10	37	13	67 108 31	67 108 31	67 108 31	55 42 74	46	33	33	33 20	15	21	56	9	16	12	13	10	244	251
252	40 99 127 75 30	20 189	8 19 37 32	11 72	165	27 13	15	72 60 66	49 59 65 139 41	342 192	190 10 35 20	66	7 46 15	10	204 62	35 9 43	7	9 17 9	62	23	8	8	23	22 55	7 26	4935	252
261	6 4 11 3 6	7	1 2 6 7	3 30 28 13	23 12	9	3	2 1 1 3	12	20 9 27 81	3 1 6 2	2	19	40 17 15 16	11 7	2	2	1 4 6 1	2	2	6	6	2	2	2	2	2	261
262	51	5 2 11	35	95 32 76	17 84	3	8	7 11 3	7 54	20 3 27 81	3 1 6 2	2	19	12 2 12 4	6	2	6 11	1 4 6 1	2	2	6	6	2	2	2	2	2	262
263		17 31			17 84		88	3 42 59	76	20 33 41 207	56 35			160 19	29 213													263
264	15	15	13 47 135 1	35	23	10	20	20	20	20 30 32	63	56	63	53	56	149	116 32	42 9	26	19	13	42 32	10	10	12	69	20	264
265					15	15	40 39	25	25	25	32	42	32	42	32	55 58 14 108	31	41	18	11	14	14	7	7	7	7	7	265
271	104 87	22 69	45 103 165	10	26 225 26 42	70 61	8	20 495 26	157	227 100 437 91	234 242 44 82 339	321	75	146 271 110 42	33 70	40	11 24	12	9	9	43 78 19 276 18	11 24	12	9	9	9	9	271
272	26 48 8 50 76	41	14 11	7 116 40	8	145 33	15	293 46	24	145 33	47	86	47	86	47	80 17 27	7	7	7	7	80 17 27	7	7	7	7	7	7	272
281	35 122	55	103 16	11 24	14	13 720 68	79	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	14	281
282	45 109 30 54	30	103 16	11 24	14	140	42 20 127	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	282
283	53 34 213	8 54 8	71 22	305 15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	15 44 147	305	283
291	27	27	34	90 24 267	30	15	15	61 90	50	12	99	76	146 73	60 380	99	76	79 30	6	6	6	6	6	6	6	6	6	6	291
292	16	16	13	7 23	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	292
293	11	22 13	5 47 20	7 17 20	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	293
301	11	1 20	26	9	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	11	301
302																												302
311	26 8	7 85 14 10	73 32	14 34 9	85 18 14	20	17	8 9 32	10 15 7	5 10	7 6 16 6	6 42	13 59 30 41	11 53 42 41	199 34 105 115	19 14 73 26 26	27 16 22	13	8	8	8	8	8	8	8	8	8	311
312	14 45 130	8	17 19	96 74	190	16	74	109 112	12 63	21 72 160	15 26 60	86 100	34 154 137 233	27 27 175	204 61 16	20	37 16	9	9	9	9	9	9	9	9	9	9	312
313	109 14 60 154	27 14	8 17	19	190	16	74	20 50 3	21	26 50	3	21	86 100	11 34	18 12	27	62 233 232 73	33	212	9	9	9	9	9	9	9	9	313
321	36 19 14 62 100	37 65 123 29 1	32 94	70	11 21	113	29	98 19 16 69	70 12 32 12	48	12	12	262 42	43	53 525 86 107 53	19 43	25 12 11	21	24	12	15 12 12 14	85	89	37 29	28	8	2	321
322	52 86 200	53 70 02 10	30 56	19	13	47	19	39 22	7	11 27 11	9 11	13	204 98	36 12	400 501 151 410	38 44 70	9 9	0	0	0	42	12	12	14	11	88	0	322
323	47 111 191 345	22 44 199	39	17	13	100	47	75	7	11	9 11	13	100	19	17	27	86 16 75	75 500 290	22	22	22	15 19	86	41	15	6	0	323
341	14 39 24 35	11 24 12	19	14	13	100	47	75	7	11	9 11	13	100	19	17	27	53 30 200	27 14	31	38	9	12	12	12	12	12	12	341
342																												342
401	1 47	1	11 14 8 10	13	10	10	10	97 18	8 17	6	38 18 31 10	2 6 2	49	11 18	6 17	6	11 19 21 17 105	14 26 139	14	11 22 13	10 24 0	0	10	13	2	0	2	401
402	32 38 28 64	7 5 8 20 24	7	5 16 6	42	24	7	23	15 37	6	39 13 9 18 14	1	26	47	10	36 32	57 162 9 211 27	10 11 36 16 20	35	8	11	384	081	9	16 27	18	9	402
411	25	5 13	14 10 56 41	12	19	14	7	8	8	8	8	8	8	8	8	8	14 120 24 33 21	43 52 14 29	14	10	9	9	9	9	9	9	9	411
412	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	412
413	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	413
414	32 7 20 14 1 2 8	10	2	22 10	10	13	2	10	2	2	2	2	10	9	1 5 1	1	13	13 02 28	13	2	2	2	2	2	2	2	2	414
421	30 0 13 5 18	06	10	25	12	10	25	6 12 35	4 30	1	7	1	16 12	9	11	11	11	11	11	11	11	11	11	11	11	11	11	421
422	4 2 61	18 90 20 10	10	10	56	4	5	5	10 42	4	17	4	34 73	23	5	5	5	5	5	5	5	5	5	5	5	5	5	422
423	14 37	18	32 7	14	4	5	5	14	11	50 16	63 6 11 5	1	25 12	0 8 14 6 24	7	6	6	6	6	6	6	6	6	6	6	6	6	423
431	21 5 13	5 10 14	7	5	14	11	50 16	63 6 11 5	1	25 12	0 8 14 6 24	7	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	431
432																												432
441	1 47	1	11 14 8 10	13	10	10	10	97 18	8 17	6	38 18 31 10	2 6 2	49	11 18	6 17	6	11 19 21 17 105	14 26 139	14	11 22 13	10 24 0	0	10	13	2	0	2	441
442	32 38 28 64	7 5 8 20 24	7	5 16 6	42	24	7	23	15 37	6	39 13 9 18 14	1	26	47	10	36 32	57 162 9 211 27	10 11 36 16 20	35	8	11	384	081	9	16 27	18	9	442
451	25	5 13	14 10 56 41	12	19	14	7	8	8	8	8	8	8	8	8	8	14 120 24 33 21	43 52 14 29	14	10	9	9	9	9	9	9	9	451
452																												452
461	195	1 23	147 39 122	14	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	13	461
462	32 12	24	16 67 56 100	39 16 93 77	17	15 35 10	1	9 15	10 13	1	46 23 3	16 16 40	7 10 12 21	8	1	1	1	1	1	1	1	1	1	1	1	1	1	462
501	57 16 67 56 100	39 16 93 77	17	15 35 10	1	9 15	10 13	1	46 23 3	16 16 40	7 10 12 21	8	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	501
502		86 52	58 11	58 11	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	502
511	35 30 14 0 26	14 29 7	15	19 14	6 15	20	10	34 18	19 6	17 30 6	24 7	23	17 9	22	10 2 16	20	10	6 5	10	30	7	7	7	7	7	7	7	511
512	56 38 23 75 100	29 7 14 10	7 27	13 17	33 0	0 65	59	42 52	40	12 13 20 7	52 12 26 11 9	20 3 14 3 90	42 22	34 43	20	20	10 7 16	7	7	7	7	7	7	7	7	7	7	512
521		14 29 7			33	13	49				21 25 11 7	19 10 49 10 19	33 10	34 23	15 25 23 10 7	15	16	26	14	11	16	16	16	16	16	16	16	521
522	31 6 18 31	34 7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	522
531	5 15 8	19 31 30	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	531
532	1	1 37	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	532
533	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	19	533
534	8 15	8 52	10 19 31 30	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	534
541	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	541
542																												542
551	31 32 6 137 296	34 6 92 6	23 6 55 26	5 29	10	10 34 13	26	20	33	17	38 11 21 13	15	71	7	9 36 11 35	7	7	7	7	7	7	7	7	7	7	7	7	551
552	49 31 15 34 51	7 19 0	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	552
553	11 14 56 10	19 22	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	553
554	8 12 10 19	14 41 1

BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

AUTO AND TAXI DRIVER TRIPS – AVERAGE DAY 1981 – INTERNAL AND EXTERNAL

TABLE C-2(1981)

To Zone / From Zone	001	002	003	004	005	006	007	008	009	101	102	103	111	112	113	114	121	122	131	132
001	24		13	100		3	26	26	43	21	36	43	38	15	12		20	61	36	32
002	13	35	0	33	100	14	40	130	40	14	26	26	41	200	0	14	0	21	0	0
003	13	0	14	0	14	0	0	14	0	0	0	0	0	14	0	0	0	0	0	0
004	100	33	0	14	65	25	113	70	14	43	113	70	14	43	123	14	61	161	164	127
005	13	100	14	65	123	14	43	151	43	19	43	151	43	19	123	14	61	161	164	127
006	3	14	0	25	14	2	28	40	14	0	10	31	23		10	0	24	25		10
007	26	40	0	113	43	28	4	34	43	29	24	29	24	29	43	29	24	29	24	29
008	26	130	14	70	151	40	34	2	151	17	43	151	43	17	43	17	43	151	43	17
009	43	40	0	14	43	14	43	151	2	19	43	151	43	19	43	19	43	151	43	19
101	21	14	0	43	19	0	29	17	19	2	10	31	23		10	0	24	25		10
102	36	26	0	113	43	10	24	29	43	10	4	29	24	29	43	29	24	29	24	29
103	43	26	0	70	151	31	29	2	151	23	29	4	29	23	29	23	29	29	29	23
111	38	41	0	14	43	23	24	29	43	31	24	29	4	29	43	29	24	29	24	29
112	15	200	14	200	43	0	24	17	43	23	43	23	29	2	43	17	43	23	43	17
113	12	0	0	0	19	10	29	43	19	10	43	29	43	17	2	19	43	29	43	19
114	0	14	0	61	43	0	29	17	19	0	29	23	29	43	19	2	43	29	43	19
121	24	61	0	161	151	24	24	43	43	24	24	29	24	43	43	43	2	29	43	43
122	61	161	0	164	164	25	29	151	151	25	29	29	29	23	29	29	29	4	29	29
131	36	26	0	127	127	10	24	29	43	10	24	29	24	29	43	29	43	29	2	29
132	32	0	0	0	19	10	29	17	19	10	29	23	29	17	19	19	43	29	29	2
133	29	30	40		6	31	11		28	10	17	18	9	32	24		16	33	50	23
141	67	59	61		36	66	32	35	61	298	31	19	84	100	47	136	76		46	23
142	19	27	45		10	36	45	35	19	31	32		11	10	6	13	10	10	11	10
143	66	12	100			42	11		42	17	27	23	18		49	19			10	10
144	35	40	40			35	11		35	17	27	23	18		49	19			10	10
151	37	42	37		28	41			21	38	37	56			43	121				
152	17	20	61		51	216			59	101		59			59	121				
153	11	26	10		40	40			30	40		59			59	121				
161	7	63	53	153		17	93	157	27	15	14	119	12	70	36		32	177	43	43
162	70	17	19	59		93	157	27	15		119	12	70	36			177	43	43	51
171																				
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173																				
201	15	79	25	13	65	34	13	72	26	44	12	32		57	16	15			46	
202	55	46	0	20	65	27	123	14	20	43	9	27	123	14	20	43	9		27	123
211	11	26	10	46	89		34		10	30		16	20	19		30			16	20
212	20	48	30	50	30	0	34		10		43	9			43	9			43	9
213	33	19	12	106		19	33	21			19	11								
221	15	26	0	15	44	15	43	24			15	43	24							
222	60	24	5	8	61	19	23				19	23								
231	35	74	55	102	43	33	63	34			33	63	34							
232	91	19	20	43		20	104	24	8		5	17	21	8			17	50	31	
233	10	17	10	58		10	17	10	12		10	17	10	12			10	17	10	12
234	20	19	0	16	67	20	19	0	16	67	20	19	0	16	67		20	19	0	16
235	34	12				34	12				34	12					34	12		
236	12	74	1	32	112	9	16	79	22		9	16	79	22			23	13	50	13
241	23	82		35	100	7		93	12	17	7		93	12	17		23	60		54
242	59	42		45	53	6		29		9	6		29		9		19	11		23
243	12	45		45	53	6		29		9	6		29		9		19	11		23
244	12	9	33	33	24	6		29		9	6		29		9		19	11		23
251	8	15	97	50	30	12	100				3	16	13				12	32	30	39
252	1	1	1	1	1	1	1				1	1	1				1	1	1	1
261	1	1	1	1	1	1	1				1	1	1				1	1	1	1
262	2	1	1	1	1	2	1				2	1	1				2	1	1	1
263																				
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265	7		4			9					9						9			
271			142	83		44	87				44	87					44	87		
272	77	199	19	161	202	72	33	59	23		72	33	59				72	33	27	
273	19	28	8	27	55															
274	44	49	54	43		10	60	10			10	22	47				45	47	51	
281	35	81		3	101		5	15	11		38						11	15	11	
282	23	59	19	43	16	1	25	43	11		1	25	43	11			1	25	43	11
283	23	59	19	43	16	1	25	43	11		1	25	43	11			1	25	43	11
284	23	59	19	43	16	1	25	43	11		1	25	43	11			1	25	43	11
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External Total	2167	390	2642	1444	1449	1453	1448	1791	2337	1631	1703	2444	9850	1525	1525	841	2559	2165	2412	2556
Grand Total	5285	3263		6498	797				4708				2148	2885	355	1 833			2949	3381

To Zone / From Zone	133	141	142	143	144	151	152	153	161	162	171	172	173	201	202	211	212	213	214	221	222	223	231	232	233	234	235	236
001		61	16	32	29				7	63				201	22	211	212	213	214	221	222	223	231	232	233	234	235	236
002		21	107	41	7					14				35	55	43	12	19	19	12		113	55	32	25	12	55	32
003		14	14	14	14									14	14	14	14	14	14	14		14	14	14	14	14	14	14
004		43	16	135	135					113	36			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
005		43	16	135	135					113	36			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
006		24												12	2	2	2	2										
007		61	24	29	24					14				23	2	5	2	5	2	2		2	2	2	2	2	2	2
008		161	164	127	127					113	36			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
009		43	19	43	19					43	19			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
101		24												12	2	2	2	2										
102		61	24	29	24					14				23	2	5	2	5	2	2		2	2	2	2	2	2	2
103		43	17	43	17					43	17			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
111		61	24	29	24					14				23	2	5	2	5	2	2		2	2	2	2	2	2	2
112		43	17	43	17					43	17			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
113		43	19	43	19					43	19			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
114		43	19	43	19					43	19			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
121		43	43	43	43					43	43			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
122		29	29	29	29					29	29			29	29	93	29	93	79	29	43	85	33	12	33	47	60	135
131		43	29	43	29					43	29			43	29	93	29	93	79	29	43	85	33	12	33	47	60	135
132		19	29	19	29					19	29			19	29	93	29	93	79	29	43	85	33	12	33	47	60	135
133		23	50	23	50					23	50			23	50	23	50	23	50	23	50	23	50	23	50	23	50	23
141		92		92						92				92		92		92		92		92		92		92		92
142		10	10	10	10					10	10			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
143		10	10	10	10					10	10			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
144		10	10	10	10					10	10			10	10	10	10	10	10	10	10	10	10	10	10	10	10	10
151		121								121				121														
152		121								121				121														
153		121								121				121														
161		43	43	51	43					43	29	20		43	29	20												
162		177	43	43	51					177	43	43		177	43	43												
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173																												
201		46								46				46														
202		27	123	14	20	43	9			27	123	14	20	43	9													
211		16	20	19		30				16	20	19		30														
212		43

BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

BUS PASSENGER TRIPS — AVERAGE DAY 1981 - INTERNAL

TABLE C-4 (1981)

| To Zone / From Zone | 001 | 002 | 003 | 004 | 005 | 006 | 007 | 008 | 009 | 101 | 102 | 103 | 111 | 112 | 113 | 114 | 121 | 122 | 123 | 124 | 131 | 132 | 133 | 134 | 141 | 142 | 143 | 144 | 145 | 146 | 151 | 152 | 153 | 161 | 162 | 171 | 172 | 173 | 201 | 202 | 203 | 204 | 211 | 212 | 213 | 214 | 221 | 222 | 223 | 224 | 231 | 232 | 233 | 234 | 235 | 236 | 241 | 242 | 243 | 244 | 251 | 252 | 253 | 261 | 262 | 263 | 264 | 265 | 271 | 272 | 273 | 281 | 282 | 283 | 291 | 292 | 293 | 294 | 301 | 302 | 311 | 312 | 313 | 321 | 322 | 323 | 324 | 331 | 332 | 333 | 341 | 342 | 401 | 402 | 411 | 412 | 413 | 414 | 421 | 422 | 423 | 431 | 432 | 441 | 442 | 451 | 452 | 461 | 462 | 501 | 502 | 511 | 512 | 521 | 522 | 531 | 532 | 533 | 534 | 541 | 542 | 551 | 552 | 553 | 554 | 561 | 562 | 571 | 572 | 573 | 574 | 581 | 582 | 583 | 591 | 592 | GRAND TOTAL | To Zone / From Zone |
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BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

TRUCK DRIVER TRIPS - AVERAGE DAY 1981 - INTERNAL AND EXTERNAL

TABLE D-1(1981)

From Zone \ To Zone	001 002 003 004 005	006 007 008 009 101	102 103 111 112 113	114 121 122 123 131	132 141 142 143 144	145 146 151 152 153	161 162 171 172 173	201 202 211 212 213	214 221 222 223 231	232 233 234 235 236	241 242 243 244 251	252 253 261 262 263	264 265 271 272 273	274 275 276 277 281	282 283 291 292 293	294 301 302 303 311	312 321 322 323 324	331 332 333 341 342	401 402 411 412 413	414 421 422 423 431	432 441 442 451 452	461 462 501 502 511	512 521 522 523 531	532 533 534 541 542	551 552 553 554 561	562 563 571 572	TOTAL	101 402 403 404 405	406 408 409 411 412	413 414	External Total	GRAND TOTAL	To Zone or Station	From Zone
001	10 10 0 30	3 33	3 8	15			1 0	12 14 13 19 8		10 0	3 13 13	2 2 7 2	3 2 8	23	8	13 1 1 5	36 23	6 3		9 19	6	3	7	10 20 19	13 0	8	26 60	31	409	3 3	8	26	409	001	From Zone
002	0 53 0 43	3 37 50				16 17	0	1 4 9		10 15	6 10 10	1 26 4	2 8	44 11 44	3 21	1 1	1	8 6			8	1	0	0	1 0	1 0	110	2	2 2 2	2	110	221	002	002
003	0 0 16	2 12 29	3	6	33	10	10 23 22 10	16 14	9	9 9	6 19	1 1	2	7	2 13	44 11	8 21	1	8	6	13	34 0	9	2	4 6 3	12	12	170	2	2 2	2	170	204	003	003
004	46 40 0 9 41	6 47 37 22						12		9	10	2	3 2	9	14 3 13	1 15	1	1					3	3 2	2		33	1178	11 13 7 2 2 27		33	1178		004
005	60 51 29 93	19 103 33																																	
006	20 0	8 5 16 19 5	2	6	9		9			15 18	3	6	2	2	9	2	11	17	1	8 5 7	3	3	3 12 3	3	3 6	12	290	1 2		25 11	24	290	006	006
007	31 16 52 20	6 6 20 12								0 0 13	10 19	0	8	2	0	0	3	10	2	1	2	2	8	2	6	4	619	3	2	19	31	619	007	007
008	25 80 7 51 103	6 57 134 82 0	14 13 3 3	6	16	9	14	55	10 19	9 14	6 19	20	5	9	1	3	21	22	1	1 15 1	1	1	17 0	0	17 17	0	1426	1 3	3 6 1 1 37	23	123	1426	008	008
009	3 21 5	22 13 12 42								5 9 13	9	5			5		1	1		1			0	0	0	0	912	1 3	35 20 1 3 30	0	62	912	009	009
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102		16 3	3 3	6 46	3	10 3	2	8	9	9 1	11 11	1 1	3 2 8	2	3	1 15 2	7				3	3	2 15 12	14	31	155	102	102
103	6 8	17 16 3	64 0	0 11	11 9	3	8	6	7	3	3	3 7 3	10 8	13	7	7	26	26		1	9 17	7	11	6	12	9	287	103	103		103	287	103	103
104	3 8	16	0	9	10	14	2	40	12	6 0 9	3	2	2	12	6	7		22	1	1	17	6	6	3	10	6	412	104	104		104	412	104	104
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BILLINGS METROPOLITAN AREA
TRANSPORTATION STUDY

TOTAL VEHICLE TRIPS – AVERAGE DAY 1981 – INTERNAL AND EXTERNAL

TABLE E-1 (1981)

To Zone	001 002 003 004 005	006 007 008 009 010	011 012 013 014 015	016 017 018 019 020	021 022 023 024 025	026 027 028 029 030	031 032 033 034 035	036 037 038 039 040	041 042 043 044 045	046 047 048 049 050	051 052 053 054 055	056 057 058 059 060	061 062 063 064 065	066 067 068 069 070	071 072 073 074 075	076 077 078 079 080	081 082 083 084 085	086 087 088 089 090	091 092 093 094 095	096 097 098 099 100	101 102 103 104 105	106 107 108 109 110	111 112 113 114 115	116 117 118 119 120	Internal Total	Ext. Total	To Zone or Station
001	42 16	21 109	14 28 31	43 21	36 98 46 15	12	20 100 30 13	01 16 32 77	17	8	26 63 17 41	37	52 16 13 27 35	11 36 17	17 66 25	16	9 9	62 9	44 32	27	12	36	59	20 9	2595	120	50 6	63 64 30 128	58 42	2595	4 22 10 4 3	10 20 1	40	88	211	2806	001	From Zone
002	30	17	6 155	18	70 106 81 128	80	13	19 10 10 117	11	5	19 10	10	19 10 10 117	19	10	10	7	9	10 10	10	10	10	10	10	2686	120	50 6	64 30 128	58 42	2686	4 29 33 5 3	10 20 1	40	88	217	2903	002	
003	30	17	13	14	25 23	9	13	10	10	10	10	10	10	10	10	10	7	9	10 10	10	10	10	10	10	658	120	50 6	64 30 128	58 42	658	4 29 33 5 3	10 20 1	40	88	217	875	003	
004	152 202	13 224	320	18	49 340 68 66	121	166 201 164 175	6	26	26	51 26 15 8	9	9	0 11	12	8	9	9	7 7	8	7	8	7	8	4127	252	111 140	46 39	252	111 140	46 39	4127	10 31 14	21 21 30 40	9 9	40	88	1027	4215	004	
005	152 202	13 224	320	18	49 340 68 66	121	166 201 164 175	6	26	26	51 26 15 8	9	9	0 11	12	8	9	9	7 7	8	7	8	7	8	4127	252	111 140	46 39	252	111 140	46 39	4127	10 31 14	21 21 30 40	9 9	40	88	1027	4215	005	
006	12 96	3 80 21	50 31	9	10 48 23	6	10	24 25	10	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	1253	20	10 40	9 10	20	10 40	9 10	1253	2 17 2	2	3	130	44	189	1442	006	
007	40 40	91 52	28	16	24 45	6	10	03 192	2	25	83 192	2	25	83 192	2	25	83 192	2	25	83 192	2	25	83 192	2	2284	5	4	3	5	4	3	2284	5	3	3	130	44	189	2473	007	
008	133 381	10 105 349	53 114 280	130	49 102 45	10	58	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	3125	25	10	10	25	10	10	3125	5	5	3	130	44	189	3314	008	
009	11 30	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	841	3	3	3	3	3	3	841	3	3	3	130	44	189	1030	009	
010	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	1436	7	7	7	7	7	7	1436	7	7	3	130	44	189	1625	010	
011	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7	1436	7	7	7	7	7	7	1436	7	7	3	130	44	189	1625	011	
012	52 102	12 14 27	7	48	20 104 20 26	15	17 34 27	10	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	26	1436	20	10	10	20	10	10	1436	2	3	3	130	44	189	1625	012	
013	87 199	18 67 284	45	20	104	70	48	20	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	2436	10	10	10	10	10	10	2436	6	9	3	130	44	189	2625	013	
014	25 94	31	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	70	1784	70	70	70	70	70	70	1784	9	17	3	130	44	189	1973	014	
015	24 64	7	22	22	10	24	22	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	1955	10	10	10	10	10	10	1955	5	22	10	130	44	189	2144	015	
016	21 34 24	23 103	5 14 62 17	24	61 73 32 38	45	91 30 90 36	10	14 176 12 15	6	9 21 40 14	7	27 10	10	5 10 16 20	7	19 21	7	7 1 3 1	7	31 5 7	19	17	10	2336	48 17	15	10	12	12	11	2336	12	16	3	130	44	189	2525	016	
017	61 87	7	20	20	44	21	126 112	7	32 12	6	35 201 285 15	6	10 70 19 14	6	10 46 13 20	6	10 69 31	6	1 15 1 27	11	6 8	6	9	6	3460	16 32	9	6	12	23	20	3460	16	32	3	130	44	189	3649	017	
018	60 97	60 149	71 164	24	12 69	7	21 26	11	96	24	130 12	54	59	24	13	24	26	8	8	24	8	24	8	24	3905	113	15	24	113	15	24	3905	31	36	3	130	44	189	4094	018	
019	6 45	31	5 47	7	12 69	7	21 26	11	96	24	130 12	54	59	24	13	24	26	8	8	24	8	24	8	24	3905	113	15	24	113	15	24	3905	31	36	3	130	44	189	4094	019	
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022	10 87	10 95	40 43	21	22 46	7	10 31	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	10	11900	22 44	342	21	98	29	32	14	10	181	12	393	1200	13900	022	
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025	77 12	7	28	41	37 80	41	23	16 12	41	17	72 52	41	17	72 52	41	17	72 52	41	17	72 52	41	17	72 52	41	3471	12 15 45	24	10	5	4	19	15	39	217	3	393	1200	3864	025	
026	17 65	61	37 80	41	86	37	66	122 10 24	34	73	67 75	41	17	67 75	41	17	67 75	41	17	67 75	41	17	67 75	41	3904	49 52 100	55	14	41	3	19	15	39	217	3	393	1200	4297	026	
027	59 101	59 101	55 216	150	100	55	100	40	12	40	12	40	12	40	12	40	12	40	12	40	12	40	12	40	3152	11 61 11	11	40	12	40	12	3152	11	40	3	130	44	189	3341	027	
028	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	24	1370	24	24	24	24	24	24	1370	24	24	3	130	44	189	1559	028	
029	59 19	17 16 109	15 93 21	16 9	67 22	7	10	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	9	1353	2 12 5	5	2	9	3	13	5	51	137	4	1499	2	1636	029	
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Internal Total	2637 5731	2920 9332	2146 2957	225	5142 2790	1309	2346 3310	1605 4002	1421 3336	1605 4002	2271	126	2406 1092	1306	1309 1016	1309	2040 2013	2040 4483	1797	2804 3287	2804 3287	1608	374 3030	374 1170	914	650 320	325 6471	4145	3354 5128	4177 4225	2530	2212 397	495 1123	401	2633	2299	267	2563	813	1095	1530	420	2047	292	967	758	859	289	2287	563	365	491	715	632	419	1225	366	281	1666	657	534	947	1904	1999	3912	2588	552	9	212916	Internal Total
001	2 4 5 20	7 3 38	2 20 7	4	5 9 8	2	4 12 5	3	4 12 5	3	4 12 5	3	21 2 2	1	3 1 6	9	1 1 1	1	1	1	1	1	1	1	1	3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1